Atmospheric air in relation to tuberculosis : (with 93 plates) / by Guy Hinsdale.

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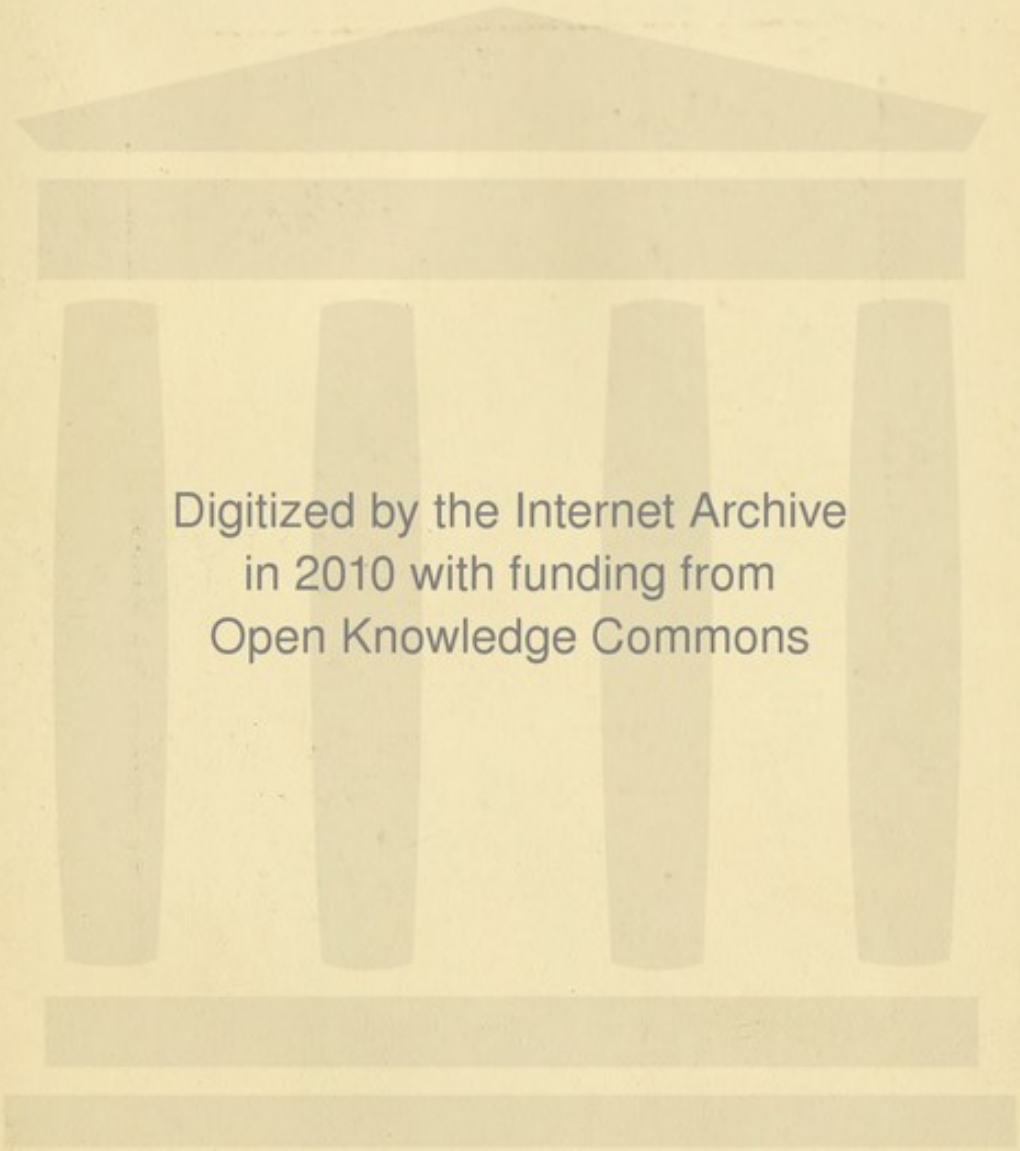

SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 63, NUMBER 1

Hodgkins Fund

ATMOSPHERIC AIR IN RELATION TO TUBERCULOSIS

(With 93 Plates)

BY

GUY HINSDALE, A. M., M. D.

Hot Springs, Virginia.

Secretary of the American Climatological Association; Ex-President Pennsylvania Society for the Prevention of Tuberculosis; Fellow of the College of Physicians of Philadelphia; Associate Professor of Climatology, Medico-Chirurgical College; Member of the American Neurological Association; Fellow of the Royal Society of Medicine, Great Britain; Corresponding Member of the International Anti-Tuberculosis Association, etc.

(Publication 2254)

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ADVERTISEMENT

The accompanying paper, by Dr. Guy Hinsdale, on "Atmospheric Air in Relation to Tuberculosis," is one of nearly a hundred essays entered in competition for a prize of $1,500 offered by the Smithsonian Institution for the best treatise "On the Relation of Atmospheric Air to Tuberculosis," to be presented in connection with the International Congress on Tuberculosis held in Washington, September 21 to October 12, 1908. The essays were submitted to a Committee of Award, consisting of Dr. William H. Welch, of Johns Hopkins University, Chairman; Prof. William M. Davis, of Harvard University; Dr. George M. Sternberg, Surgeon-General, U. S. A., Ret'd; Dr. Simon Flexner, Director of Rockefeller Institute for Medical Research, New York; Dr. Hermann M. Biggs, of New York, General Medical Officer, Department of Health, New York City; Dr. George Dock, Medical Department, Washington University, St. Louis; and Dr. John S. Fulton, of Baltimore, Secretary General of the Congress on Tuberculosis. Upon the recommendation of the committee, the prize was divided equally between Dr. Guy Hinsdale, of Hot Springs, Virginia, and Dr. S. Adolphus Knopf, of New York City.

At the request of the Institution, Dr. Hinsdale has revised his essay so as to indicate some of the advances made in the study of the subject during the past five years.

CHARLES D. WALCOTT,
Secretary of the Smithsonian Institution.

WASHINGTON, DECEMBER, 1913.

TERMS OF COMPETITION

SMITHSONIAN INSTITUTION

HODGKINS FUND PRIZE

In October, 1891, Thomas George Hodgkins, Esquire, of Setauket, New York, made a donation to the Smithsonian Institution, the income from a part of which was to be devoted to "the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man." In furtherance of the donor's wishes, the Smithsonian Institution has from time to time offered prizes, awarded medals, made grants for investigations, and issued publications.

In connection with the approaching International Congress on Tuberculosis, which will be held in Washington, September 21 to October 12, 1908, a prize of $1,500 is offered for the best treatise "On the Relation of Atmospheric Air to Tuberculosis." Memoirs having relation to the cause, spread, prevention, or cure of tuberculosis are included within the general terms of the subject.

Any memoir read before the International Congress on Tuberculosis, or sent to the Smithsonian Institution or to the Secretary-General of the Congress before its close, namely, October 12, 1908, will be considered in the competition.

The memoirs may be written in English, French, German, Spanish or Italian. They should be submitted either in manuscript or typewritten copy, or if in type, printed as manuscript. If written in German, they should be in Latin script. They will be examined and the prize awarded by a Committee appointed by the Secretary of the Smithsonian Institution in conjunction with the officers of the International Congress on Tuberculosis.

Such memoirs must not have been published prior to the Congress. The Smithsonian Institution reserves the right to publish the treatise to which the prize is awarded.

No condition as to the length of the treatises is established, it being expected that the practical results of important investigations will be set forth as convincingly and tersely as the subject will permit.

The right is reserved to award no prize if in the judgment of the Committee no contribution is offered of sufficient merit to warrant such action.

CHARLES D. WALCOTT,
Secretary of the Smithsonian Institution.

WASHINGTON, D. C., FEBRUARY 3, 1908.

PREFACE

The rapid progress in the antituberculosis movement throughout the world in the last five years has made it necessary to make some changes in the present essay as originally presented to the Smithsonian Institution in 1908. Much that then seemed novel appears almost commonplace now. An extraordinary amount of research has been carried out with reference to the atmospheric air during these later years. The whole theory of ventilation has been stated in new terms; the presence of ozone in the atmosphere, a subject that has always appealed to the popular fancy since its discovery, has been restudied and its physiologic action assigned a value different from that commonly ascribed to it; the properties of strong sunlight and Alpine air have been marshalled for the combat with surgical tuberculosis, particularly in children.

Physiologists in Europe and America have lately made most interesting studies of the blood at the higher altitudes and their observations are constantly throwing new light on the entire subject of aerotherapy, replacing old impressions and beliefs with a scientific basis on which we may confidently build.

There never was a time when the outdoor life and the accessories for the atmospheric treatment of all tuberculous persons were so well systematized and placed in harmony with the other hygienic measures adopted for their cure.

What the result has been we have endeavored to show and what the future holds for us we are eagerly awaiting.

May the Smithsonian Institution, through its Hodgkins Fund, continue to stimulate inquiry and disseminate the fruits of the worldwide efforts to the better understanding of the great problems that yet remain unsolved.

GUY HINSDALE.

HOT SPRINGS, VA., DECEMBER, 1913.

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ATMOSPHERIC AIR IN RELATION TO TUBERCULOSIS

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CHAPTER I. INTRODUCTION

We are compelled to acknowledge at the outset the difficulty or impossibility of analyzing the relationship of atmospheric air to tuberculosis so as to isolate the influence of all other factors. It would be totally useless and impossible to consider air independent of sunlight, heat, rainfall, the configuration of the earth's surface; racial characteristics, social environment, including dwellings, clothing, food, and drink.

As a resultant of all these and many other factors in the tuberculosis problem, we obtain the figures of mortality which are published from time to time by various cities, states, and nations. The problem seems incapable of solution. One might as well survey an oak that has grown for centuries and set out to determine the relative value of the atmospheric air, the sunlight, the rainfall, and the various constituents of the soil and its environment in producing the sturdy, deeply rooted, and wide-spreading tree which has seen ages come and go.

The world-wide efforts now made to determine the nature of this infection and especially its bacteriologic and pathologic character are accompanied by a general effort to limit its spread. We are encouraged to believe that future generations will be provided with a practical and efficient method of destroying this insatiate monster.

Undoubtedly we have begun at the right end, but we only began within the memory of nearly all of us, only thirty-two years ago, when the true cause of the disease was first isolated and revealed to the human eye.

Previously we were as the blind leading the blind, groping about in search of special climates, special foods or medicines, meeting with more or less success in so far as the dietetic, hygienic, out-of-door plan of treatment was carried out. These curative measures succeeded then, as they succeed now, but preventive measures

worthy the name were entirely unknown. The enemy once revealed in its hiding place, and various facts in its life history determined, the logical result was a gradual—very gradual—dawn which promised better things. Now the world has seen a great light and we wonder how intelligent men could have dwelt in those caverns of ignorance and even refused to come out for years while the men in the laboratory beckoned with signs which then seemed so uncertain but now so clear. As late as 1890 the medical mind did not grasp the necessity for preventive measures. As one asleep it heard voices but was slow to waken; it starts and rubs its eyes and looks about, waiting for some word or message that will bring it to its senses.

It was in 1891 that the first society for the prevention of tuberculosis was organized. This was started in France by M. Armaingaud, of Bordeaux. The second was the Pennsylvania Society for the Prevention of Tuberculosis organized in Philadelphia in 1892. These were the pioneers in Europe and America. They devoted their energies to a campaign with three cardinal features: (1) the education of the public in reference to the nature of the disease and its means of prevention; (2) the passage of suitable laws regarding notification, the restriction of expectoration, disinfection, etc.; and (3) the care of consumptives and the establishment of sanatoria by public or private means in suitable localities.

The wonderful growth of this movement for preventive measures is now seen in the establishment of 1,228 societies for the prevention of tuberculosis in America alone, and in the erection of 527 sanatoria in this country (1913).[1] The State of Pennsylvania alone has appropriated in one Act of Legislature $2,000,000 for this purpose and one citizen of the state, Mr. Henry Phipps, has given an equal amount for the scientific study as well as the practical treatment of this disease in all its bearings.[2]

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[1] The State of New York leads all other states in the number of new organizations and institutions established during the last two years. The total number of beds for consumptives in the United States now exceeds 33,000.

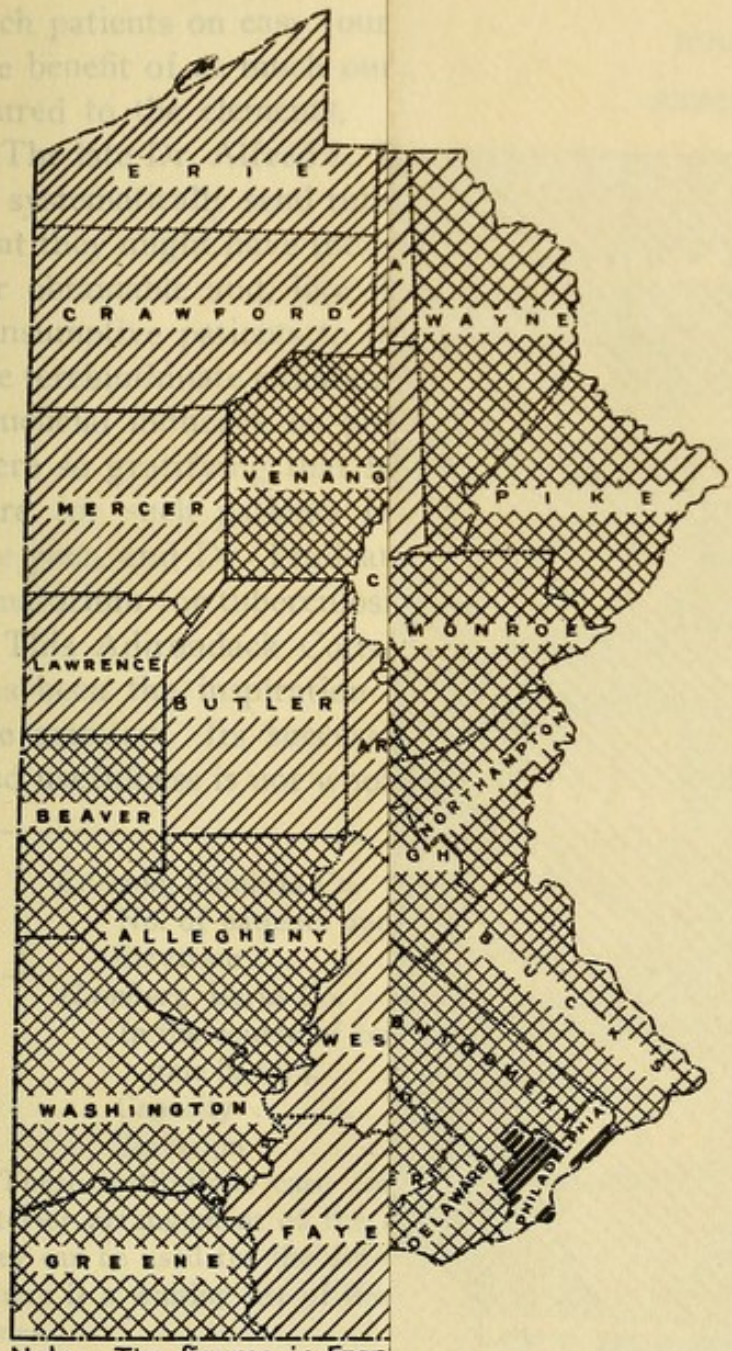
[2] The Pennsylvania legislature appropriated $1,000,000 in 1907, $2,000,000 in 1909, $2,624,808 in 1911, and $2,659,660 in 1913 for tuberculosis work alone. This is under the direction of Dr. Samuel G. Dixon, the Commissioner of Health.

There are at the present time two State Sanatoria in Pennsylvania in operation.

Mont Alto, Franklin Co.

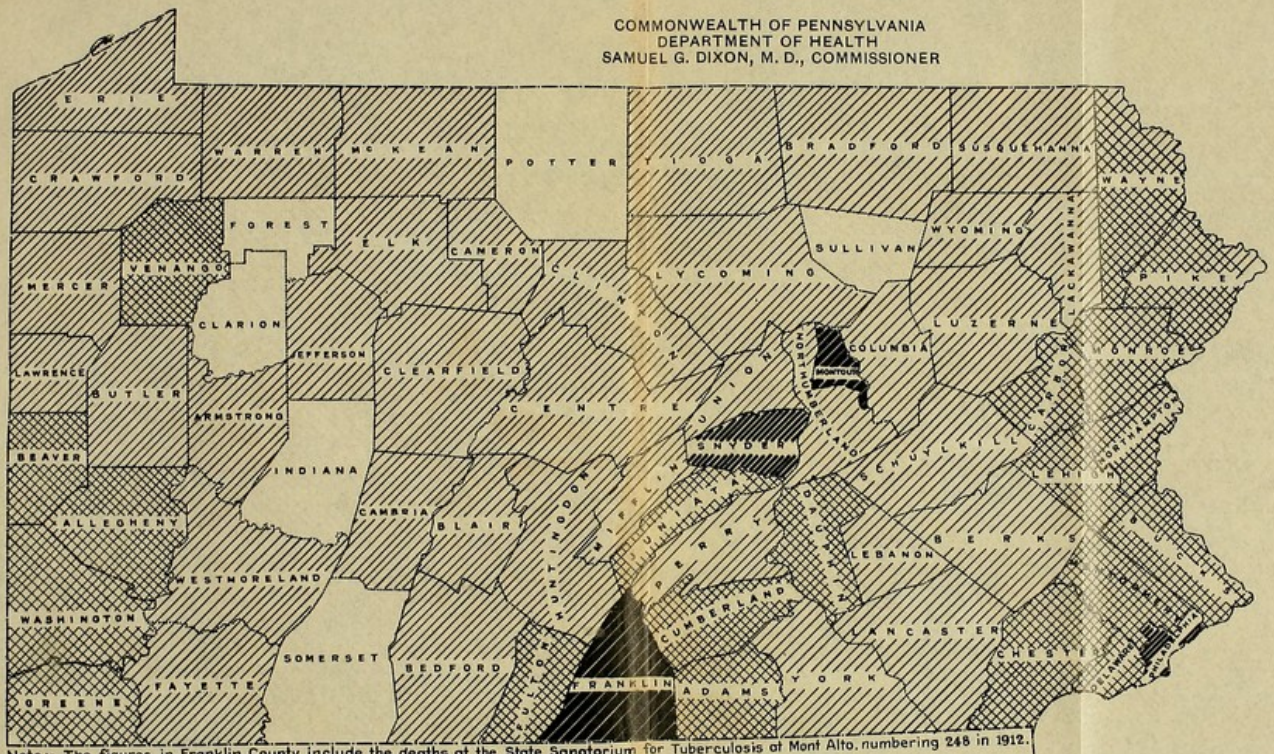
No. of patients under treatment..... 957

Elevation .....1,650 ft.



Note:- The figures in Fran
The death rate for

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
SAMUEL G. DIXON, M. D., COMMISSIONER



Note:- The figures in Franklin County include the deaths at the State Sanatorium for Tuberculosis at Mont Alto, numbering 248 in 1912. The death rate for Franklin County exclusive of Mont Alto would be 118.

Deaths per 100,000.

0-49	100-149	200 and above
50-99	150-199	

MAP SHOWING DISTRIBUTION OF PULMONARY TUBERCULOSIS IN PENNSYLVANIA BY COUNTIES FOR THE YEAR 1912

The late Dr. Henry I. Bowditch, of Boston, was one of the first physicians in America to recognize the value of constant out-door life in the treatment of tuberculosis and was accustomed to send such patients on easy journeys by carriage so that they might have the benefit of as much out-door air as possible, becoming gradually inured to the elements.

The late Dr. Alfred L. Loomis, of New York, was one of the first to systematically send tuberculous patients to the Adirondack forest that they might have the benefit of the purest and most invigorating air obtainable and, like the physicians of ancient Rome who sent consumptive patients to the pine forests of Libya, he believed that the terebinthinate exhalations from the standing pines exerted a most beneficial influence on pulmonary affections. Dr. Loomis's results were so gratifying that he encouraged Dr. Edward L. Trudeau to care for such patients in the Adirondack Mountains throughout the year, and Dr. Trudeau, with his help, founded in 1884 the first sanatorium for tuberculosis in America.[1]

This Adirondack Cottage Sanitarium, now in its thirtieth year, has been the inspiration of sanatoria for tuberculosis throughout the country. Its success in restoring so many patients to health and usefulness is not wholly estimated in figures. It has established

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Cresson, Cambria Co.
No. of patients under treatment..... 337
Elevation .....2,550 ft.
Hamburg, Berks Co.
In the course of construction and will be completed some time in 1914.
Capacity 480
Elevation ..... 550 ft.

These institutions care for both incipient and far advanced cases. The interior arrangement of the sanatoria at Cresson and Hamburg is such that they can be used for the different classes of cases as demand may necessitate. There is a waiting list of those desiring admission to these institutions at all times.

The State maintains 115 Tuberculosis Dispensaries, which are located throughout the 67 counties in the commonwealth. There are 220 physicians and 120 visiting nurses employed in these dispensaries.

By the courtesy of Dr. Samuel G. Dixon, Commissioner of Health, we are able to show in a map the distribution of tuberculosis in the counties of Pennsylvania (pl. 1). This shows, as in an earlier map by the author, that the disease is least prevalent in the higher, forest covered regions of the State.

[1] A. L. Loomis, M. D. Evergreen Forests as a therapeutic agent in pulmonary phthisis (Trans. Amer. Climatological Ass., Vol. 4, 1887). See page 134.

a practical method of cure and has done much to correct the earlier unfounded and mischievous notions that prevailed as to what was necessary for the cure of tuberculosis.

Taking this institution as an example, let us see what bearing it may have on our general subject, the relation of the atmospheric air to tuberculosis:

(a) It is in the midst of an evergreen forest of over 10,000 square miles; (b) the atmosphere is pure, or at least as pure as may be obtained on the continent; (c) the air is moderately moist; (d) the rainfall averages 35 inches; (e) the air is moderately rarefied, owing to (f) an elevation of 1,750 feet; (g) owing to its northern situation (latitude 44°) and its elevation (1,750 feet) (h) the climate is cold in winter and (i) subject to rather sudden changes with an annual range of 59° C. or 138° F.

CHAPTER II. VALUE OF FORESTS, MICRO-ORGANISMS, ATMOSPHERIC IMPURITIES

GENERAL BENEFIT OF FORESTS

It has come to be an axiom in phthisiology that the air of an evergreen forest is eminently suitable for a patient with tuberculosis.[1] As we have previously mentioned, the pine forests of Libya were used two thousand years ago for the cure of "ulcerated lungs." At that period the pines abounded and gave the locality a reputation as a health resort for affections of the lungs. But the ravages of time, aided by fire and sword, not to speak of domestic needs, have obliterated all vestiges of these ancient forests.

The successful institutions located in the Hartz Mountains, the Black forest of Germany, in the Forest of Ardennes, the State Forest Reserve of Pennsylvania, and the Adirondack Forest in New York owe much of their success to the abundant use of the purest air both day and night.

European Governments have long recognized the great value of

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[1] The following quotation from Pliny shows that it was generally agreed in his day that the forests and especially those which abound in pitch and balsam are the most beneficial to consumptives or those who do not gather strength after long illness, and that they are of more value than the voyage to Egypt:

"Sylvas, eas duntaxat quae picis resinaeque gratia redantur, utilissimas esse phthisicis, aut qui longa aegritudine non recolligant vires, satis constat; et illum coeli aera plus ita quam navigationem Aegyptiam proficere, plus quam lactis herbidos per montium aestiva potus."—C. Plinii, Hist. Nat. lib. XXIV, Cap. 6.

ST. BLASIEN IN THE BADEN BLACK FOREST, GERMANY
Courtesy of Dr. Sander

SANATORIUM ST. BLASIEN IN THE BADEN BLACK FOREST, GERMANY. ELEVATION 800 METERS (2,600 FEET). THE AIR OF THE FIR FOREST IN THE CURE OF TUBERCULOSIS

Photograph Furnished by Dr. Albert Sander

their forests and have protected them by strictly enforcing intelligent laws so that they may be forever preserved and improved. The history of forestry in the United States and Canada has been that of ruthless, unrestrained, wholesale destruction of nearly all our standing pine, and heavier spruce. In recent years, however, we have seen the establishment of Government reserves, State reserves, and State laws for their protection; the organization of the American Forestry Association, the American Forest Congress, the Society for the Preservation of the Adirondack Forest; the Schools of Forestry at Yale, Harvard University and Mont Alto, Penna. All these remedial measures have come very late, but will undoubtedly exert a strong influence for good.[1]

Aside from the generally beneficial influence of forests, universally recognized by climatologists, these natural parks have proved the means of restoring thousands of persons suffering from tuberculosis and diseases of the respiratory system.

QUALITIES OF FOREST AIR AND SOIL

The qualities of forest air and forest soil have been studied by E. Ebermayer[2] who shows that, like that of the sea and mountains, forest air is freer from injurious gases, dust particles, and bacteria. It was shown that the vegetable components of the forest soil contain less nutritive matter (albuminoid, potash, and phosphates and nitrates) for bacterial growth; that the temperature and moisture conditions are less favorable; that the sour humus of the forest soil is antagonistic to pathogenic bacteria; finally that, so far, no pathogenic microbes have ever been found in forest soil; hence this soil may be called hygienically pure.

The soil is protected from high winds by forest growth and undergrowth; the upper soil strata are slow to dry out and wind sweeping over them carries few micro-organisms into the air. As may be expected, fewer microbes are found in forest air than outside their limits. Serafini and Arata have proved this experimentally.[3] They

[1] The chief forester of the United States has in 1913 under his care in 160 forest reservations a total of 165,000,000 acres of forest land. The present Chief Forester has done excellent work in the prevention of serious forest fires.

[2] E. Ebermayer: (1) Hygienic significance of forest air and forest soil. (2) Experiments regarding the significance of humus as a soil constituent; and influence of forest, different soils, and soil-covers on composition of air in the soil. Wollny, 1890 (Hygeia, August, 15, 1891).

[3] Serafini and Arata: Intorno all 'azione dei boschi sui mikro organismi transportati dai venti.

exposed plates in the forest air and on its outskirts and tabulated their countings of bacteria for forty successive days from May 6. They made three classes—molds, liquefying and non-liquefying bacteria. They found that, with one exception, one or two of these classes were always less numerous in the forest than on its outskirts and generally from twenty-three to twenty-eight times less. Serafini makes the point that bacteria coming from the outside are reduced in number by a sort of filtration process. Thus we see that the air of forests is comparatively free from endogenous and exogenous bacteria—none of them in any case being pathogenic.[1]

CARBON DIOXIDE IN FORESTS

Puchner shows that the air in the forest contains generally more carbonic acid gas than in the open, due to the decomposition of litter.[2] But this difference must be almost inappreciable. As we know, the law of diffusion of gases renders it impossible for variations in the relative proportion of the atmospheric constituents to be more than transitory. Diffusion is greatly favored by the winds which sweep through the tree tops, especially where they are not too crowded.

The fact that so many sanatoria for tuberculosis are located in or near forests makes it very important to dwell a little longer on the constituents of the air in these localities. We know that forests, as well as all other forms of vegetal growth, take up large quantities of carbonic acid, retaining the carbon and rejecting the oxygen, and the question naturally arises, does it sensibly change the relative quality of either constituent so that the composition of the air is slightly different in the woods? Prof. Mark W. Harrington, lately chief of the United States Weather Bureau, undertook to answer that question, both with reference to carbonic acid, oxygen, and ozone, with some interesting results.[3] Repeated observations show that each constituent is curiously uniform in quantity in the free air. It has been thought that carbonic acid is quite variable but the introduction of better methods of observation shows that, except in confined places where the gas is produced, the variations are very

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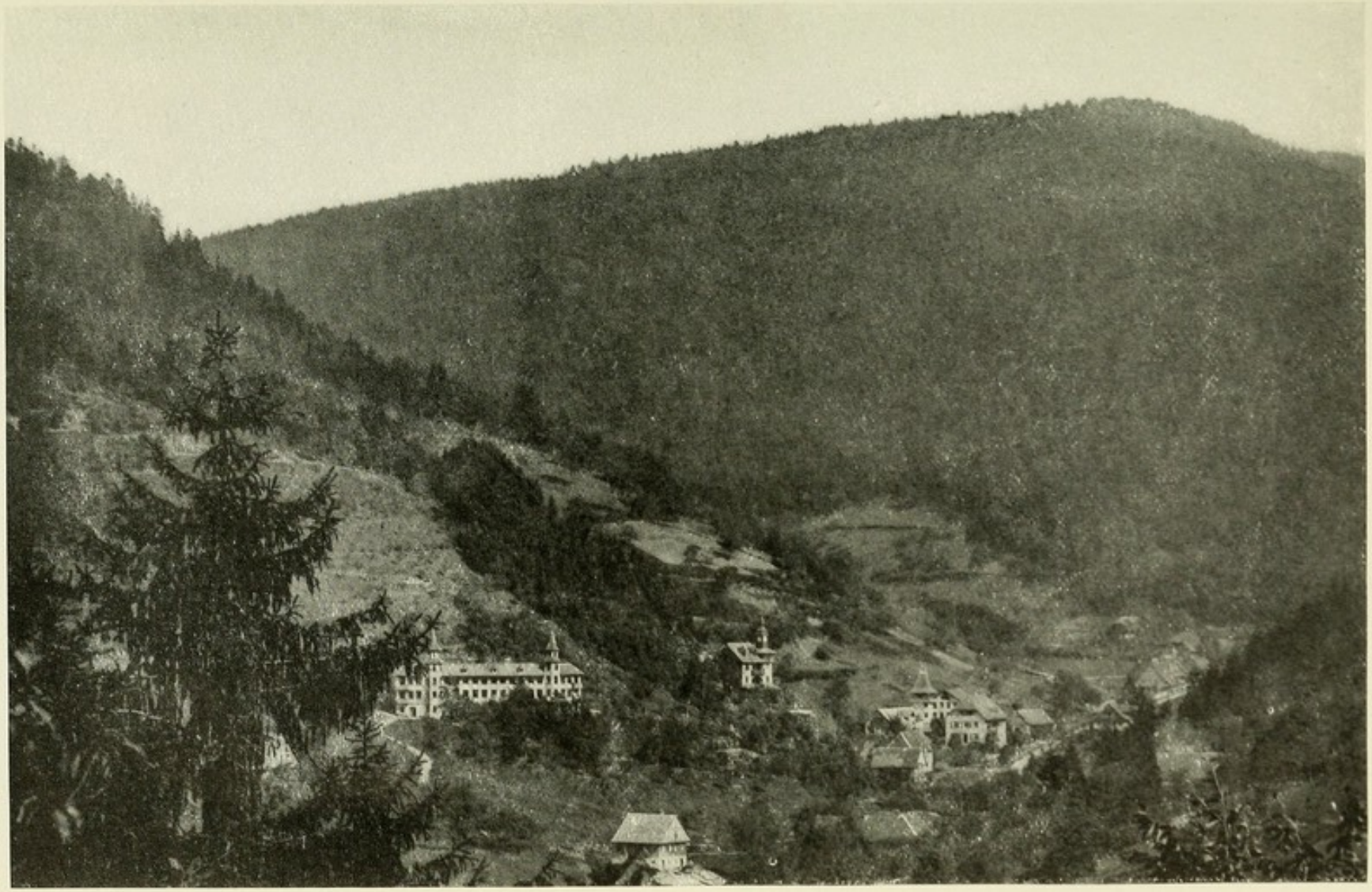
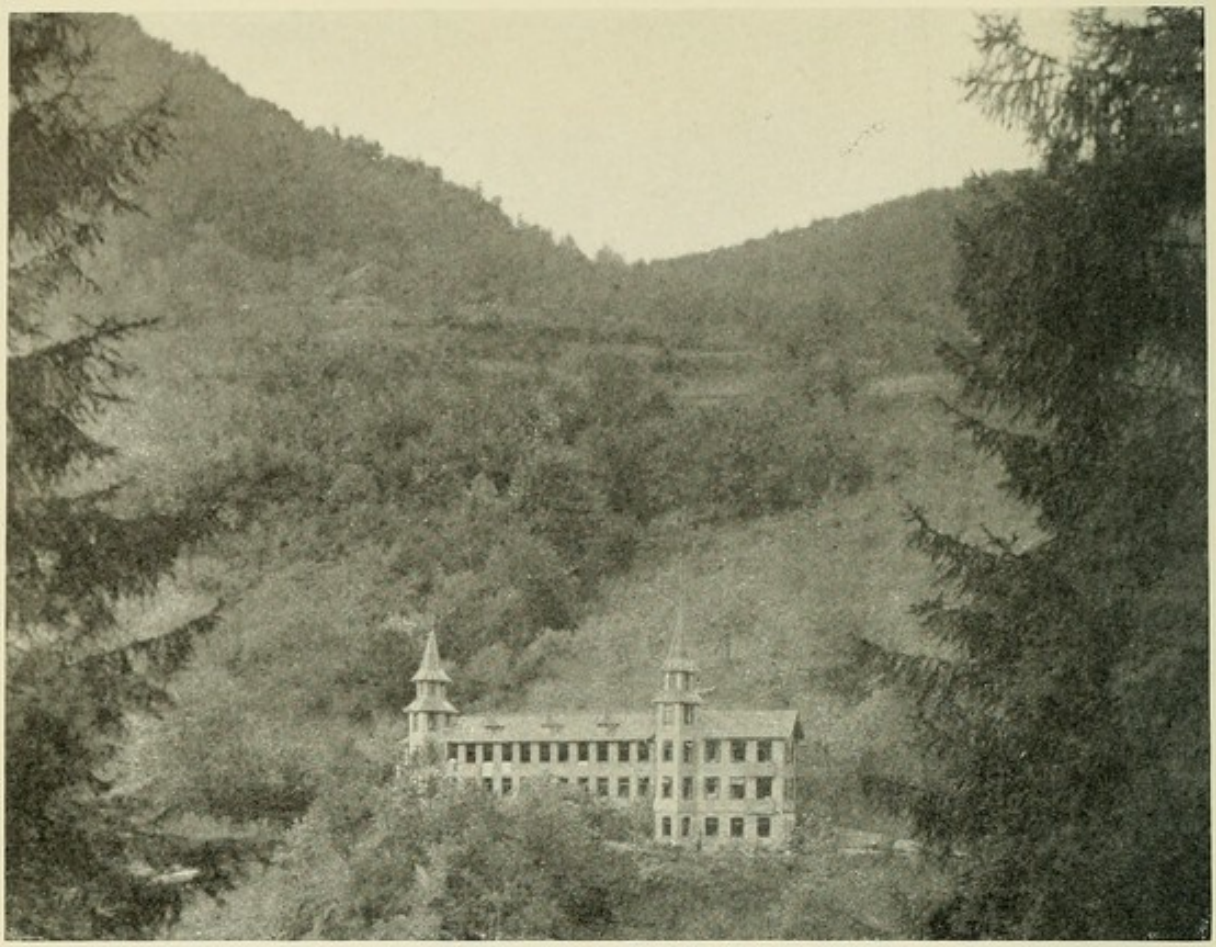
[1] See B. E. Fernow: Forest Influences, U. S. Dep. Agriculture, Forestry Division Bulletin No. 7, pp. 171-173.

[2] H. Puchner: Investigations of the Carbonic Acid Contents of the Atmosphere.

[3] M. W. Harrington: Review of Forest Meteorological Observations, U. S. Dep. Agriculture, Forestry Division Bulletin No. 7, p. 105.



DR. WALTHER'S SANATORIUM, NORDRACH-COLONIE, BLACK FOREST, GERMANY



DR. WALTHER'S SANATORIUM, NORDRACH-COLONIE, BLACK FOREST, GERMANY

VIEW FROM THE ADIRONDACK COTTAGE SANITARIUM
"In the foreground are the pines and my only business in life is to sit and look at them"
Courtesy of Journal of The Outdoor Life

small. A little study shows that the carbonic acid gas taken up by a forest is a very small quantity compared with that which passes the forest in the same time with the moving air. Grandeau[1] estimated the annual product of carbon by a forest of beeches, spruces, or pines as about 2,700 pounds per acre. This corresponds to 9,900 pounds of carbonic acid gas or 69,300 cubic feet. Now, if the average motion of the air is five miles an hour, a low estimate, and the layer of air from which the gas is taken be estimated at one hundred feet thick, there would pass over an acre 550 million cubic feet in one hour. This air must contain about three parts in ten thousand of carbonic acid gas and the total amount of the latter per hour is 165,000 cubic feet. But this is two and two-thirds, or more than twice as much as that taken up by the trees in the entire season, so that the air could provide in thirty minutes for the wants of the trees for the entire season. Prof. Harrington shows that the ratio of carbonic acid used to that furnished is only one part in 8,600.

OXYGEN IN FORESTS

Again, the additions of oxygen to the air would form a still smaller percentage of the oxygen already present, for this gas makes up 20.938 per cent of the air against a thirtieth of one per cent obtainable from this source.

OZONE IN FORESTS

The occurrence of ozone in the air of forests, especially coniferous forests, has been credited, since its discovery by Schoenbein in 1840, with affording remarkable health-giving qualities. This opinion has become firmly fixed in the minds of the public and, to a large extent, has been accepted by the medical profession as an evidence of high oxidizing power at once corrective of decaying vegetation and exhilarating and curative to mankind. Popular belief usually has some basis for its existence; indeed, meteorologists made regular estimations of ozone in the atmosphere by testing with sensitized papers and the results were published in connection with statistics of health resorts.[2]

The Schonbein test is based on the power of ozone to free iodine from a solution of potassium iodide in contact with starch, when a violet color is developed in the sensitized paper. Unfortunately the

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[1] See Belgique Horticole, Vol. 35, 1885, p. 227.

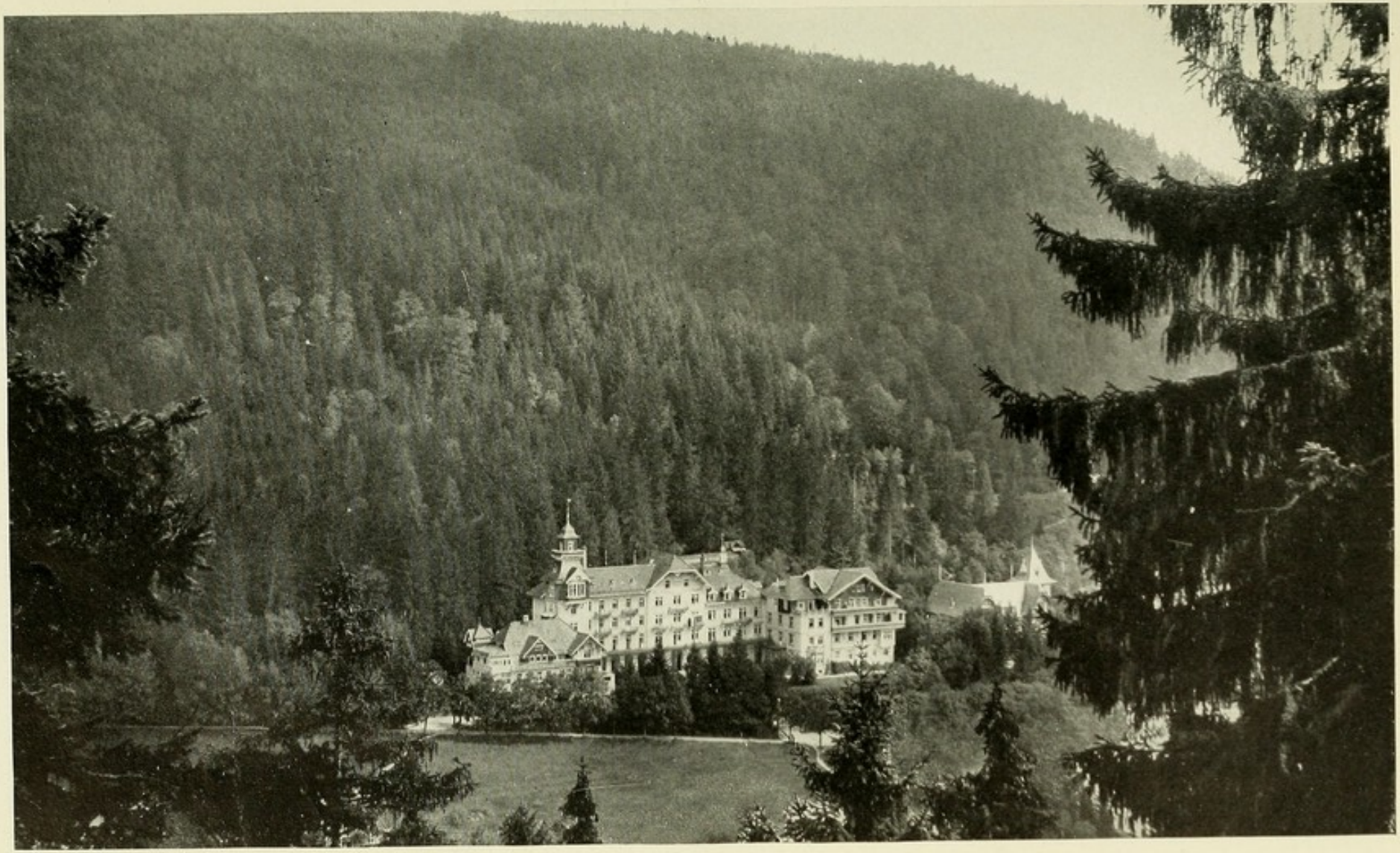
[2] See Transactions American Climatological Association, Vol. 5, p. 118.

discovery of important sources of error has destroyed the value of observations made in this manner. Other substances in the air have been found to act as reducing agents; secondly, the color after having appeared may be altered or destroyed by substances, such as sulphurous acid and many organic substances. Again, the test acts only in a moist atmosphere and, besides that, varies in intensity according to the amount of the wind, so that, in a way, it is a measure of humidity and of wind.

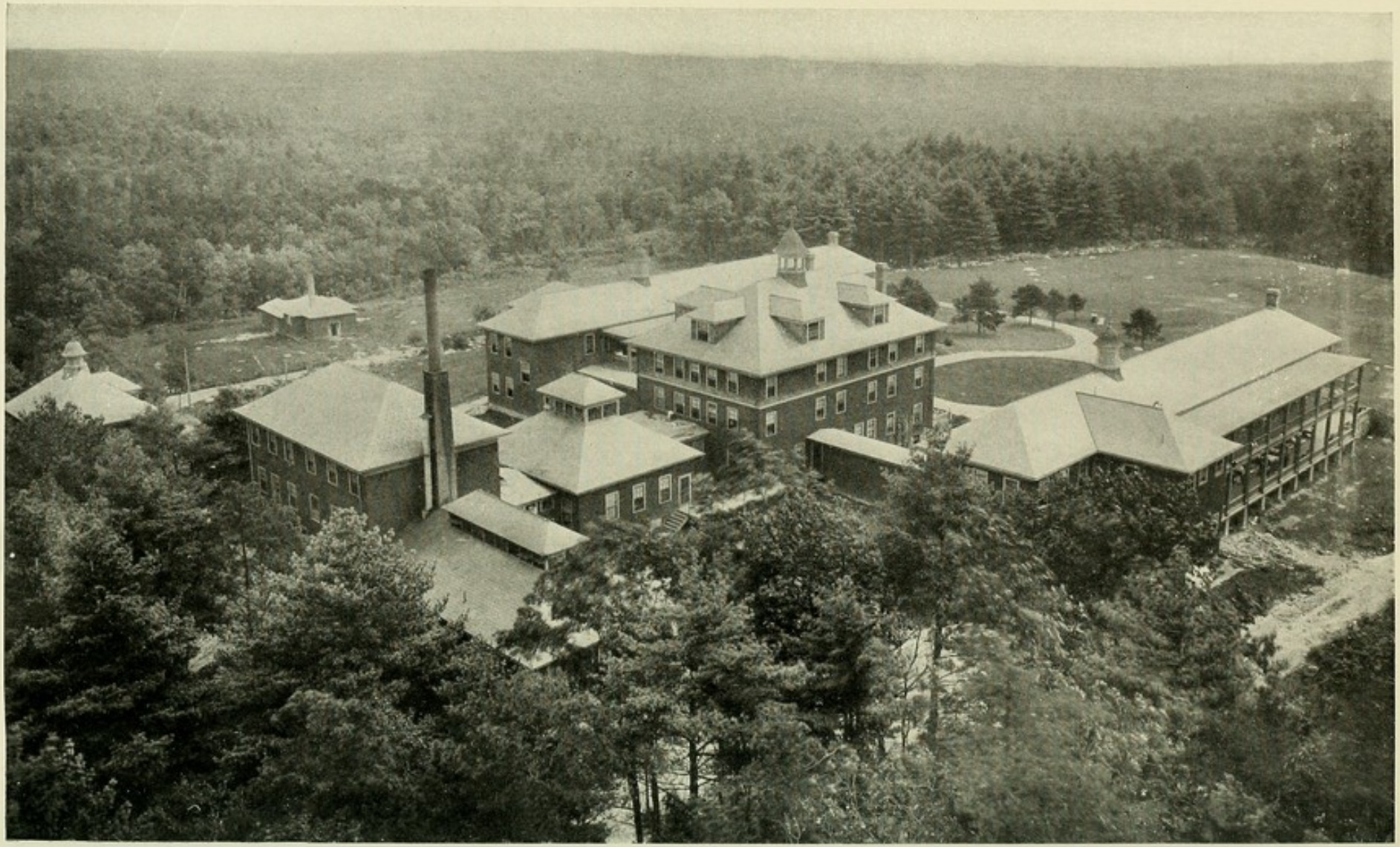
A more recent test, mentioned by Huggard as more sensitive, depends upon the use of what is known as tetra-paper, but is also considered uncertain. The full name of this reagent is tetramethyl-paraphenylendiamin paper. Notwithstanding the unsatisfactory nature of these tests, the conclusion seems to be accepted that ozone is more abundant in May and June and least abundant in December and January; more abundant in the forests and the seashore and in mid-ocean and least abundant in towns where it commonly cannot be detected. The following quotation is from page 332 *et seq.* of Vol. 1, Watts' Dictionary of Chemistry:

> Very little is known respecting the proportion of ozone in the atmosphere, or of the circumstances which influence its production. The ozonometric methods hitherto devised are incapable of affording accurate quantitative estimations. Air over marshes or in places infested by malaria contains little or no ozone. No ozone can be detected in towns or in inhabited houses.
>
> Houzeau determines the relative amount of ozone in the air by exposing strips of red litmus paper dipped to half their length in a 1 per cent solution of potassium iodide. The paper in contact with ozone acquires a blue colour from the action of the liberated potash upon the red litmus. The iodised litmus paper is preferable to iodised starch paper (Schönbein's test-paper) which exhibits a blue coloration with any reagent which liberates iodine, *e. g.*, nitrous acid, chlorine, etc. From observations made with iodised litmus paper Houzeau concludes that ozone exists in the air normally, but the intensity with which it acts at any given point of the atmosphere is very variable. Country air contains at most $\frac{1}{450000}$ of its weight or $\frac{1}{700000}$ of its volume of ozone. The frequency of the ozone manifestations varies with the seasons, being greatest in the spring, strong in summer, weaker in autumn, and weakest in winter. The maximum of ozone is found in May and June, and the minimum in December and January. In general, ozone is more frequently observed on rainy days than in fine weather. Strong atmospheric disturbances, as thunder storms, gales, and hurricanes, are frequently accompanied by great manifestations of ozone. According to Houzeau, atmospheric electricity appears to be the most active cause of the formation of atmospheric ozone.

It has been found that the air immediately above the tree tops and at the margin of the forest is richer in ozone than that of the interior, where a portion of it is utilized by the decaying vegetation. Ozone certainly aids in purifying the air by oxidizing animal or



SANATORIUM ST. BLASIEN IN THE BADEN SCHWARZWALD 800 METERS ABOVE SEA-LEVEL



RHODE ISLAND STATE SANATORIUM FOR TUBERCULOSIS AT WALLUM LAKE
Courtesy of Dr. Harry Lee Barnes

vegetable matter in process of decay and by uniting with the gases produced by their decomposition. It can, therefore, be found in considerable amounts where the air is particularly pure. This amount rarely exceeds one part in 10,000. "There is somewhat more ozone on mountains than on plains and most of all near the sea. Water is said by Carius to absorb 0.8 of its volume of ozone." [1]

This statement by Mr. Russell seems to us extraordinary in view of the minute quantity contained in the atmosphere and apparently needs confirmation, especially in view of Russell's next statement that a great excess of ozone is destructive to life, and oxygen containing one two-hundred and fortieth part of ozone is rapidly fatal, and further, that even the ordinary quantity has bad effects in exacerbating bronchitis and bronchial colds, and some other affections of the lungs.

Ozone is not found in the streets of large towns or usually in inhabited rooms, but in very large, well-ventilated rooms it is sometimes, though rarely, detected. According to Russell it may be formed by the slow oxidation of phosphorus and of essential oils in the presence of moisture. When produced by electric discharges its pungency of odor is said to make it easily perceptible when present only to the extent of one volume in 2,500,000 volumes of air and the smell may sometimes be noticed on the sea beach.

Since the discovery of ozone by Schönbein, not much has been learned about the actual origin of this allotropic form of oxygen. Its presence in and near forests and living plants has undoubtedly supported the popular view that the air of forests is particularly healthful and that living plants in our apartments are likewise beneficial.[2]

The existence of hydrogen peroxide in air was first established by Meissner in 1863, but we have no knowledge of the proportion in which it is present. All information as to its relative distribution is obtained from determinations of its amount in rain water and snow. The proportion seems to vary, like that of ozone, with the seasons of the year and with the temperature of the air. It is not improbable that the amount of hydrogen peroxide in air is greater than that of ozone, and it is possible that many so-called ozone manifestations are in reality due to peroxide of hydrogen. Watts' Dictionary of Chemistry.

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[1] Francis A. R. Russell: The Atmosphere in Relation to Human Life and Health, Smithsonian Miscellaneous Collections, Vol. 39 (Publication No. 1072), 148 p., Washington, 1896.

[2] See J. M. Anders: House Plants as Sanitary Agents, Lippincott & Co., 1887.

A recent paper by Sawyer, Beckwith and Skolfield[1] of the Hygienic Laboratory of the California State Board of Health, is one of the latest researches which discredit the claim made for ozone as a purifier of air. During recent years circulars have been issued in great numbers by manufacturers of apparatus stating that ozone is a "necessity" for the destruction of infectious germs and bacterial life, for the sterilization of air in operating rooms for the purification of air in homes of persons suffering from contagious diseases and for giving to offices and homes the invigorating air of the country, seashore and mountains.[2]

How false these claims are can readily be seen from the systematic work of these investigators, the details of which we cannot give here but to which the reader is referred. Among their conclusions are the following:

> During these tests certain physiologic effects of the "ozone" were noticed by the experimenters after they had been working around the machines. The immediate effect of inhaling the diluted gas was a feeling of dryness or tickling in the nasopharynx, and sometimes the irritation was felt in the chest. If the exposure was prolonged, watering of the eyes, and occasionally a slight headache, resulted. The smell of the "ozone" and its irritation was much more noticeable to persons who came suddenly under its influence than to those who were continuously exposed.
>
> 1. The gaseous products of the two well-known ozone machines examined are irritating to the respiratory tract and, in considerable concentration, they will produce edema of the lungs and death in guinea-pigs.
>
> 2. A concentration of the gaseous products sufficiently high to kill typhoid bacilli, staphylococci and streptococci, dried on glass rods, in the course of several hours, will kill guinea-pigs in a shorter time. Therefore these products have no value as bactericides in breathable air.
>
> 3. Because the products of the ozone machines are irritating to the mucous membranes and are probably injurious in other ways, the machines should not be allowed in schools, offices or other places in which people remain for considerable periods of time.
>
> 4. The ozone machines produce gases which mask disagreeable odors of moderate strength. In this way the machines can conceal faults in ventilation while not correcting them. Because the ozone machine covers unhygienic conditions in the air and at the same time produces new injurious substances, it cannot properly be classed as a hygienic device.

Another paper even more elaborate than this was published at the same time by Edwin O. Jordan, Ph. D., and A. J. Carlson, Ph. D.,

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[1] The Alleged Purification of Air by the Ozone Machine. Journ. Amer. Med. Ass., Sept. 27, 1913, p. 1013.

[2] See Amer. Journ. Physiologic Therapeutics, Nov.-Dec., 1911.

of Chicago.[1] This investigation was carried on at the suggestion of and under a grant from the Journal of the American Medical Association. Their experiments were carried out (1) to determine the germicidal action of ozone on pure cultures under the conditions commonly used in testing disinfectants, and (2) to determine the effect of ozone on the ordinary air bacteria. They found, after a long series of experiments detailed in full in their paper, that no surely germicidal action on certain species of bacteria could be demonstrated by the usual disinfection tests with amounts of gaseous ozone ranging from 3 to 4.6 parts per million. The alleged effect of ozone on the ordinary air bacteria, if it occurs at all, is slight and irregular even when amounts of ozone far beyond the limit of physiologic tolerance are employed.[2] The toxication of strong concentrations of ozone through injury to the lungs was marked. Even in moderate amounts it produced an irritation of the sensory nerve endings of the throat and a headache due to irritation, corrosion and consequent hyperemia of the frontal sinuses. Consequently the use of this poisonous gas as a therapeutic agent is either valueless or injurious.

USE OF FOREST RESERVATIONS FOR SANATORIA

We cannot leave the subjects of forests and forest air without strongly advocating the use of forests and especially State and Governmental forest reserves for institutions, hospitals, and camps for the tuberculous. The State of Pennsylvania has large forestry reservations, amounting at present to 1,000 square miles in 23 counties, and maintains a State School of Forestry, where young men are in training for its forest service. Acting under liberal forest laws, Dr. J. T. Rothrock, then State Forestry Commissioner, in 1903, announced that citizens of Pennsylvania are entitled to the privilege of using the forestry reservation of the state under proper restrictions as a residence while regaining health and recommended it especially to those in need of fresh air treatment of tuberculosis. In the spring of that year Dr. Rothrock, with State aid, started the construction of a few small cabins for the use of such patients and called it the South Mountain Camp Sanatorium.[3] This is situated

[1] Ozone: Its Bactericidal Physiologic and Deodorizing Action. (Journ. Amer. Med. Ass., Sept. 27, 1913, Vol. 61, pp. 1007-1012).

[2] This is corroborated by the recent article by Konrich, Zur Verwendung der Ozone in der Lüftung. (Zeitschr. Hyg., 1913, Vol. 73, 443.)

[3] Charities and Commonwealth, Dec. 1, 1906. Journ. Amer. Med. Ass., 1907. Journal of the Outdoor Life, Jan., 1907, and Feb., 1908.

in Franklin County, Pennsylvania, in the southern tier of counties where the state owns 55,000 acres. The altitude of the camp is 1,650 to 1,700 feet. It is now the site of the great State Sanatorium known as Mont Alto with a capacity of over 1,000 patients.

At first the patients were obliged to provide and to prepare their own food, but the legislature afterward appropriated enough to enable the management to furnish food, and the results were better than before. Only patients in the incipient stages were admitted, and of the 141 so cared for (up to the year 1908) about 75 per cent were either much improved or cured. The charge to the patients was one dollar per week for all supplies and services, excepting washing and the care of their cabins and their persons. The large forestry reserve allows of an indefinite extension of this method of dealing with the disease, and the small expense seems to point to it as a way to provide for the large class of patients who must be cared for in the incipient stages if the disease is to be checked and its victims restored to society as safe and potent factors in industrial progress. Dr. Rothrock, who has just closed twenty years of distinguished service to the state in the forestry commission, believes that the forest reservations furnish an answer to the further problem of how to care for the consumptive whose disease is arrested, but whose financial condition demands that he must still be cared for until able to return to his home. Pennsylvania has nearly a million acres of forest reservation, much of which needs replanting with young trees. To do this requires a large number of men, and the task of raising and transplanting trees is mostly light outdoor labor, well suited to the convalescent consumptive. In addition, there are various forms of woodcraft, such as basket making and the manufacture of small rustic articles that could easily be carried on under healthful conditions in the forests. The example of Pennsylvania suggests the propriety of other states taking similar steps and providing for the large number of consumptives who need care in an inexpensive and at the same time effective manner.

The United States Government should establish without delay large forest reserves in the Eastern, Middle, and Southern States. The White Mountains of New Hampshire and the Southern Appalachians should be placed under a system of Federal protection. It is encouraging to note that by a recent decision (November, 1913) of the Courts of New Hampshire the way is opened for the condemnation of mountain land in that State and indemnity has been awarded private owners for land so taken.

The United States has 165,000,000 acres of national forests and France and Germany combined, 14,500,000 acres.

The site of a model sanatorium for tuberculosis has the purest air or air nearly devoid of floating matter. It is only on very high mountain tops or in mid ocean, or in the Polar ice fields that we can have air free from suspended matter. The good results obtained in the higher Alpine sanatoria and in long sea voyages, in given cases of tuberculosis, are attributable in some degree to this absence of irritating or polluted atmosphere. In the more northern sanatoria, of which the Adirondack Cottage Sanitarium is a type, the long winter in which snow covers the ground for possibly five months, is always recognized as the best season for patients. The gain in health acquired during one winter equals that of two summers. The added freedom which the snow covering provides against dust and other atmospheric impurities may have its hygienic influence for the cure of tuberculosis.

MICRO-ORGANISMS IN RESPIRATORY PASSAGES

It is interesting to learn something of the fate of micro-organisms when inhaled by a person in health or by those whose respiratory passages are already suffering from irritation or disease. It has been calculated that upward of 14,000 organisms pass into the nasal cavities in one hour's quiet respiration in the ordinary London atmosphere.[1] Tyndall showed by his experiments with a ray of light in a dark chamber that expired air, or more exactly the last portion of the air of expiration is optically pure. In other words, respiration has freed the inhaled air from the particles of suspended matter with which it is laden. These experiments coincide with those of Gunning of Amsterdam in 1882 and those of Strauss and Dubreuil in 1887. Grancher has made many experiments with the expired air of phthisical patients and has never found in it the tubercle bacillus or its spores. Charrin, Karth, Cadéac, and Mallet have had corresponding results.

These germs are probably all arrested before reaching the trachea; they halt in the upper air passages. The interior of the great majority of normal nasal cavities is perfectly aseptic. On the other hand the vestibules of the nares, the vibrissæ lining them and all crusts formed there are generally swarming with bacteria. All germs are arrested here and the ciliated epithelium rapidly ejects them.

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[1] On Researches by Drs. St. Clair Thomson and R. T. Hewlet. Lancet, January 11, 1896.

By experiments on the mucous membrane of the dorsal wall of the pharynx, Thomson and Hewlet found that a particle of wet cork was conveyed at the rate of 25 mm. or one inch per minute.

Wurtz and Lermoyez have published researches on the action of nasal mucus upon the anthrax bacillus and they hold that it exerts a bactericidal influence on all or nearly all pathogenic agents in different degrees of intensity.

Thomson and Hewlet corroborate this to the extent of saying that the nasal mucus "is possessed of the important property of exerting an inhibitory action on the growth of micro-organisms." Their experiments upon each other were very ingenious and highly interesting. They were able to demonstrate that in ordinary air of the laboratory under the conditions observed, 29 moulds and nine bacterial colonies developed; whereas after passing through the nose the air contained only two moulds and no bacteria.

On another occasion they found in nine liters of laboratory air, six moulds and four bacterial colonies, while the same quantity of air after passing through the nose exhibited one mould and no bacteria. Thus they show that practically all, or nearly all, the micro-organisms of the air are arrested before reaching the naso-pharynx; probably a majority are stopped by the vibrissæ at the very entrance to the nose and those which do penetrate as far as the mucous membrane are rapidly eliminated. They state that the nasal mucus is an unfavorable soil for the growth of organisms and in this it is aided by the ciliated epithelium and lacrymal secretion.

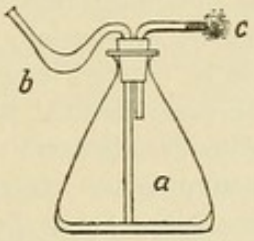
COMPOSITION OF EXPIRED AIR

Dr. D. H. Bergey in 1893-4 made some experiments in the Laboratory of Hygiene of the University of Pennsylvania under the provisions of the Hodgkins Fund of the Smithsonian Institution which are pertinent to this subject.[1] These were conducted to ascertain whether the condensed moisture of air expired by men in ordinary, quiet respiration, contains any particulate organic matters, such as micro-organisms, epithelial scales, etc. The expired breath was conducted through melted gelatin contained in a half liter Erlenmayer flask, for twenty to thirty minutes. The gelatin was then hardened

[1] J. S. Billings, S. Weir Mitchell, and D. H. Bergey: The Composition of Expired Air and Its Effects on Animal Life. Smithsonian Contributions to Knowledge, Vol. 29 (Publication 989), Washington, 1895. This investigation seemed to disprove the renowned experiments of Brown-Séquard and D'Arsonval in 1887.

by rolling the flask in a shallow basin of ice-water, thus distributing the culture in a thin layer over the bottom and sides of the flask.

These cultures were kept under observation for 20 to 30 days. About 150 cc. of gelatin was used for each experiment. The glass tube (b) of the apparatus used, which served for the entrance of the expired air, was inserted far enough to just impinge on the fluid culture medium in the flask, so that the air produced a slight agitation of the fluid in passing through the apparatus. The tube of entrance (b) is provided with a bulb-shaped enlargement which serves to retain any saliva that may flow into the tube. The tube (c) is closed with cotton so as to prevent the entrance of micro-organisms from this side of the apparatus, and a similar cotton plug is inserted in *b* when the apparatus is not in use.



Apparatus for Determining the Presence of Bacteria in Expired Breath.

It was found that the organisms developed in the cultures were all of the same character—a small yellow bacillus, common in laboratory air. When special precautions were taken to sterilize the apparatus with dry heat for an hour previous to introducing the gelatin, besides the subsequent sterilization of the gelatin, the results were negative—no growths developed. If, after standing in the working room for several days, it was found that the culture medium was sterile, the expired breath was then conducted through the apparatus and the culture was kept under observation (for the specified time in the table) at the room temperature. The nature of the organisms that developed in the first two experiments, and the absence of any growth in the others, make it probable that they developed from spores that survived the fractional sterilization of the culture medium. It is improbable that they were carried in the expired breath. Dr. Bergey also made a careful examination of the fluid condensed from the expired air with high powers, both in hanging drops and in six dried and stained preparations, but nothing resembling bacteria or epithelium was found.

The conclusion was reached that there is no evidence of a special

toxicity of the expired air. Billings, Mitchell, and Bergey say, in the monograph referred to, that the injurious effects of such air observed appeared to be due entirely to the diminution of oxygen, or the increase of carbonic acid, or to a combination of these two factors. They consider that the principal, though not the only, causes of discomfort to people in crowded rooms are excessive temperature and unpleasant odors.

We shall see, further on, that later studies show that the relative proportions of oxygen and carbonic acid are not *per se* such important factors.

Dr. Milton J. Rosenau, professor of preventive medicine and hygiene in Harvard Medical School, said in his recent address[1] on "Ether Day" at the Massachusetts General Hospital:

> One of the fallacies that has fallen is the relation of the air to the spread of infection. The virus of most communicable diseases was believed to be in the expired breath, or exhaled as emanations of some sort from the body. These emanations were said to be carried long distances—miles—on the wind. The easiest, and therefore the most natural way, to account for the spread of epidemic diseases was to consider them as air-borne. Nowadays the sanitarian pays little heed to infection in the air except in droplet infection, and the radius of danger in the fine spray from the mouth and nose in coughing, sneezing and talking is limited to a few feet or yards at most. The more the air is studied the more it is acquitted as a vehicle for the spread of the communicable diseases.
>
> It was a great surprise when bacteriologists demonstrated that the expired breath ordinarily contains no bacteria. Most micro-organisms, even if wafted into the air soon die on account of the dryness, and especially if exposed to sunshine. The relation of the air to infection is nowhere better illustrated than in the practice of surgery. At first Lister and his followers attempted to disinfect the air in contact with the wound by carbolic sprays. Now the surgeon pays no heed to the air of a clean operating room, but ties a piece of gauze over his mouth and nose, and also over his hair, to prevent infective agents from falling into the wound from these sources.

How complicated this entire subject is we can readily see from the review[2] made by Dr. Henry Sewall, of Denver, of recent experimental studies by Zuntz, Haldane, Rosenau and Amoss, Heymann, Paul, Ercklentz and Flügge, Leonard Hill and others. This review deserves to be read carefully. It sums up our latest knowledge and leads to some surprising conclusions. After describing the Black Hole of Calcutta, in which one hundred and forty-six Europeans

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[1] Boston Medical and Surgical Journal, November 6, 1913.

[2] On What do the Hygiene and Therapeutic Virtues of the Open Air Depend? by Henry Sewall, Ph. D., M. D. (Journ. Amer. Med. Ass., Jan. 20, 1912).

were confined on the night of June, 1756, and only twenty-three survived, he shows that numberless observations have all led to the one conclusion that prolonged confinement in close air tends to lower vitality and increase the incidence of certain infections, especially pulmonary tuberculosis. However, it was found many years ago that animals and men can tolerate without distress an increase of carbon dioxide in the air far beyond any concentration which it is likely to acquire under the worst conditions of crowding, provided the oxygen tension is maintained at a high level. Zuntz and Haldane and his associates show that the normal excitement of the respiratory nerve-center depends on the accumulation within it of carbon dioxide, a waste product, which it is a prime object of respiration to remove. Sewall refers to Brown-Séquard and D'Arsonval's work and, as bearing on it, the very recent work of Rosenau and Amoss.[1] These workers condensed the vapor of human expiration and injected the liquid into guinea-pigs. No symptoms followed this procedure. But after an appropriate interval of some weeks a little of the blood-serum from the person supplying the moisture was injected into the same animals. The outcome was an unmistakable anaphylactic reaction. According to current beliefs the result showed that the expired air must have contained proteid matter which sensitized the pigs toward proteids in the blood of persons from whom the first proteid was derived. The authors offer, as yet, no opinion as to whether the proteid in the expired air possesses hygienic significance.

Prof. Sewall finds a suggestive analogy in the physiologic relations of carbon dioxide which it is one of the chief objects of respiration to remove. Added to air in sufficient percentage it is deadly to animals, yet so far from its being useless in the body, Haldane and Priestley found that it must form four to five per cent of the alveolar air for the maintenance of normal respiratory movement, and a considerable lowering of its tension in the body would be followed by speedy death. Boycott and Haldane note that the subjective sense of invigoration and well-being excited by cold weather is associated with a high tension of carbon dioxide in the alveolar air.[2] After summarizing the experiments of Heyman, Paul,

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[1] Organic Matter in the Expired Breath (Journal of Medical Research, 1911, Vol. 25, 35).

[2] Haldane and Priestley: The Regulation of the Lung Ventilation (Journal of Physiology, 1905, Vol. 27, p. 225).

Boycott and Haldane: The Effects of Low Atmospheric Pressure on Respi-

and Ercklentz in Flügge's laboratory[1] which seem to show that, in people both well and sick, chemical changes in the character of the air in inhabited rooms exercise no deleterious effect on the health of the dwellers Dr. Sewall reviews Leonard Hill's work which shows that the motion of the air in the experimental chamber by means of electric fans almost entirely annulled the sense of discomfort.[2] He then cites the astonishing experiments of F. G. Benedict and R. D. Milner[3] who kept a subject for twenty-four 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.

Boycott and Haldane, referred to above, express the opinion that "the alveolar carbon dioxide tends to a lower level in warm weather" and that this diminution in the alveolar carbon dioxide is associated with a feeling of warmth of a rather unpleasant kind rather than with any absolute point on the thermometer; they hold that the rise in the carbon dioxide tension is associated with the general exhilaration and stimulation produced by cold air.

And now comes Leonard Hill, the physiologist, of London, who with his staff at the London Hospital conducted several noteworthy experiments which he described before the Institution of Heating and Ventilating Engineers in March, 1911.[4] In view of the fact that

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ration (Journal of Physiology, 1908, Vol. 37, p. 359). See also Preventive Medicine and Hygiene, by Milton J. Rosenau, M. D., Chapter 4, D. Appleton & Co., 1913. Prof. Rosenau's work contains the latest word on the bacteria and poisonous gases in the air, ventilation, etc.

Thomas R. Crowder, M. D.: A Study of the Ventilation of Sleeping Cars (Archives of Internal Medicine, January, 1911, and January, 1913). This elaborate investigation is illustrated by numerous diagrams showing the carbon dioxide content in the air from the aisles, the upper and lower berths and smoking rooms.

[1] Zeitschrift f. Hygien. u. Infectionskr., 1905, Vol. 59.

[2] Leonard Hill: The Relative Influence of Heat and Chemical Impurity of Close Air (Journal of Physiology, 1910, Vol. 41, p. 3).

See also Leonard Hill, Martin Flack, James McIntosh, R. A. Rowlands, H. B. Walker: The Influence of the Atmosphere on our Health and Comfort in Confined and Crowded Places, Smithsonian Miscellaneous Collections, Vol. 60, No. 23, p. 96 (Publication 2170), 1913.

[3] Experiments on the Metabolism of Matter and Energy in the Human Body, Bulletin 175, U. S. Dep. Agriculture Office Experiment Station, 1907.

[4] Journ. Amer. Med. Ass., April 8, 1911.

the London health authorities insist that in factories the percentage of carbon dioxide must not rise above the usual amount allowed, say ten parts in ten thousand, he remarks that the regulations do not prescribe any limitations of the wet-bulb temperature adding that while carbon dioxide does not do any harm whatever a wet-bulb temperature of 75° F. is very bad and ought not to be tolerated in any factory. All the current teaching of the hygiene of ventilation runs on the subject of chemical purity of the air; but according to Prof. Hill the essential thing in ventilation is heat, not chemical purity. It does not matter if there is 1 per cent more carbon dioxide and 1 per cent less of oxygen. In the worst ventilated rooms there is not 1 per cent less oxygen. The only effect of an excess of carbon dioxide is to make one breathe a little more deeply. A much higher amount has to be attained to have any toxic effect. As to organic impurities derived from respiration there is no physiologic evidence of their toxicity or that they are of any importance except as an indicator of the number of bacteria in air. The way to keep air best from the physiologic point of view is shown by the following experiment performed by Hill at the London Hospital: Into a small chamber which holds about three cubic meters he put eight students and sealed them up air tight. They entered joking and lively and at the end of 44 minutes the wet bulb temperature had risen to 83° F. They had ceased to laugh and joke and the dry bulb stood at 87° F. They were wet with sweat and their faces were congested. The carbon dioxide had risen to 5.26 per cent and the oxygen had fallen to 15.1 per cent. Hill then put on three electric fans and merely whirled the air about just as it was. The effect was like magic; the students at once felt perfectly comfortable, but as soon as the fans stopped they felt as bad as ever and they cried out for the fans. These and other experiments related, according to Hill, show that all the discomfort from breathing air in a confined space is due to heat and moisture and not to carbon dioxide. Even after five repetitions of the experiment there were no after-effects, such as headache. The obvious inference is that the air must be kept in motion to avoid bad effects. The open air treatment of disease is not altogether a matter of fresh air, but the constant cooling of the body by the circulation of air which makes us eat more and promotes activity. This leads to the general strengthening of the body because the blood is not only circulated by the heart but by every muscle in the body.

There cannot be efficient circulation without constant movement

and activity. If there is constant cooling by ventilation, then a person is kept more active and the general health is improved.

As Dr. M. J. Rosenau said in his recent address:

> Thus our entire conception of ventilation has changed, owing to the fact that we now do not believe that fresh air is particularly necessary in order to furnish us with more oxygen or to remove the slight excess of carbon dioxide. It is plain that it is heat stagnation that makes us feel so uncomfortable in a poorly ventilated room rather than any change in the chemical composition of the air. It has been made perfectly clear from the work of Flügge that one of the chief functions of fresh air is to help our heat-regulating mechanism maintain the normal temperature of the body. It is necessary to have some 2,000 to 3,000 cubic feet of air an hour to maintain our thermic equilibrium—just the amount that was formerly stated to be necessary to dilute the carbon dioxide and supply fresh oxygen. The practice of ventilation, therefore, has not altered so much as has our reason for attaching importance to clean, cool, moving air, which has completely changed.[1]

The foregoing résumé is perhaps not complete without mentioning the recent work of Prof. Yandell Henderson, of Yale University, who has brought forward his "Acapnia" theory (acapnia meaning diminished carbon dioxide in the blood). He says:[2]

> We have really at the present time no adequate scientific explanation for the health-stimulating properties of fresh air and the health-destroying influence of bad ventilation. . . . The subject needs investigating along new lines rather than a rehearsal of old data.

Dr. Crowder's recent experiments[3] also furnish additional evidence against the theory that efficient ventilation consists in the chemical purity of the air, in its freedom from "a toxic organic substance." Even were a poisonous protein substance present in the expired air—a fact no experimenter has yet been able to demonstrate—the human organism under every-day conditions is apparently well able to adjust itself to the reinhalation of this hypothetic substance, since a considerable quantity of the expired air is always taken back into the lungs.[4]

We consider that experiments like these demonstrate most valuable and practical truths and that is our excuse for introducing them so particularly in this place. When we consider that the average man exhales from 9,000 to 10,800 liters of air in twenty-four

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[1] Boston Medical and Surgical Journal, Nov. 6, 1913.

[2] Trans. Fifteenth International Congress on Hygiene and Demography, Vol. 7, p. 622.

[3] Crowder, Thomas R.: The Reinspiration of Expired Air (Arch. Int. Med., October, 1913, p. 420).

[4] Editorial in Journ. Amer. Med. Ass., Nov. 29, 1913. See also page 108.

hours[1] it would indeed be a terrible situation if it were true that the expired breath could convey pathogenic or other bacilli. The millions of bacilli which we take into the air passages are arrested in the air passages and for the most part mercifully destroyed by the secretion.[2] In any event we have the assurance that the expired air is free from micro-organisms. With reference to tuberculosis this means that if healthy persons are exposed only to the expired air of tuberculous subjects no infection can occur. Only through bacilli contained in the sputum or in tiny drops of moisture coughed by the patient is the disease communicated; and it is further probable that, as in the case of other infectious organisms, when once received into the nose and mouth and upper air passages, they quickly lose their activity or are soon extruded. (See page 13 *et seq.*)

ATMOSPHERIC IMPURITIES

In view of these facts it would scarcely seem necessary to state that for the treatment of all respiratory diseases and especially for the treatment of infections such as tuberculosis, which invades the larynx and the lungs, or for the treatment of patients whose throats and lungs owing to other infections, such as tonsillitis, pneumonia, or influenza, may be specially susceptible, no city air can be considered favorable. It is our duty to provide as nearly as possible air with a very low bacterial content such as may be obtained in forests or in the neighborhood of the seashore.

COAL AND SMOKE

Aside from the presence of bacteria in the air of cities and towns there are other impurities which are of great disadvantage to tuberculous patients. The prevalent use of soft, or bituminous coal in Great Britain and America, especially in manufacturing centers, undoubtedly shortens human life and hastens many a consumptive to his end. Volumes have been written on this subject and most valuable contributions have been made by Dr. J. B. Cohen, of Leeds, Mr. Francis A. R. Russell, Henry de Varigny and others, published in connection with the Hodgkins Fund.[3]

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[1] About 380 cubic feet which is equal to a volume 7⅓ feet (220 cm.) in height, width, and thickness.

[2] It has been calculated that in a town like London or Manchester, a man breathes in during ten hours 37,500,000 spores and germs. F. A. R. Russell.

[3] See Smithsonian Miscellaneous Collections, Vol. 39, 1896 (Publications 1071, 1072, 1073).

See also "The Influence of Smoke on Acute and Chronic Lung Infections," by Wm. Charles White, M. D., and Paul Shuey, Pittsburg. Trans. Amer. Climatological Association, 1913.

Dr. William Charles White and Paul Shuey, of Pittsburgh, have recently made a study of the influence of smoke on acute and chronic lung infections, selecting pneumonia and tuberculosis as a cause of death in Pittsburgh, St. Louis, Portland, Oregon, St. Paul, Cincinnati, Chicago, Philadelphia, New York, New Orleans, Richmond, Cleveland, San Francisco, Indianapolis, Minneapolis, Memphis, Boston, Mobile, and Los Angeles. They plotted the number of smoky days per year, 1907 to 1912, with the smokiest cities first and so on to the least in the order indicated above. The mortality for white population and total population and other data are noted on the accompanying chart. This study is in some respects unsatisfactory, because of the difficulty of getting data as to smoky days. The conclusion was that if we except Portland and St. Paul there is a general tendency of the tuberculosis death rate to rise as the number of smoky days in the city decreases. On the other hand, it will be seen that there is a general tendency for the number of deaths from pneumonia to fall as the number of smoky days in the city decreases. In this instance, also, Portland, St. Paul, and Boston must be excepted. All this needs confirmation.

It is a matter of common knowledge that coal miners are liable to a disease called fibrosis, anthracosis, or miners' consumption, in which the lungs receive and retain coal dust, which penetrates every nook and cranny of the lungs and adds one more element of danger to a most hazardous occupation. But we have it on the authority of Sir Frederick Treves that he had seen the lungs of many persons, who had lived in London, which were black from their surface to their innermost recesses. Such a condition, in his opinion, not only made it more difficult to resist disease, but started disease, and it was entirely due to dirt and soot inhaled. The black fog of London owes its color to coal smoke, which gives it its filthy, choking constituents, and kills people by thousands. Experiments showed that during a bad fog six tons of soot were deposited to the square mile.[1]

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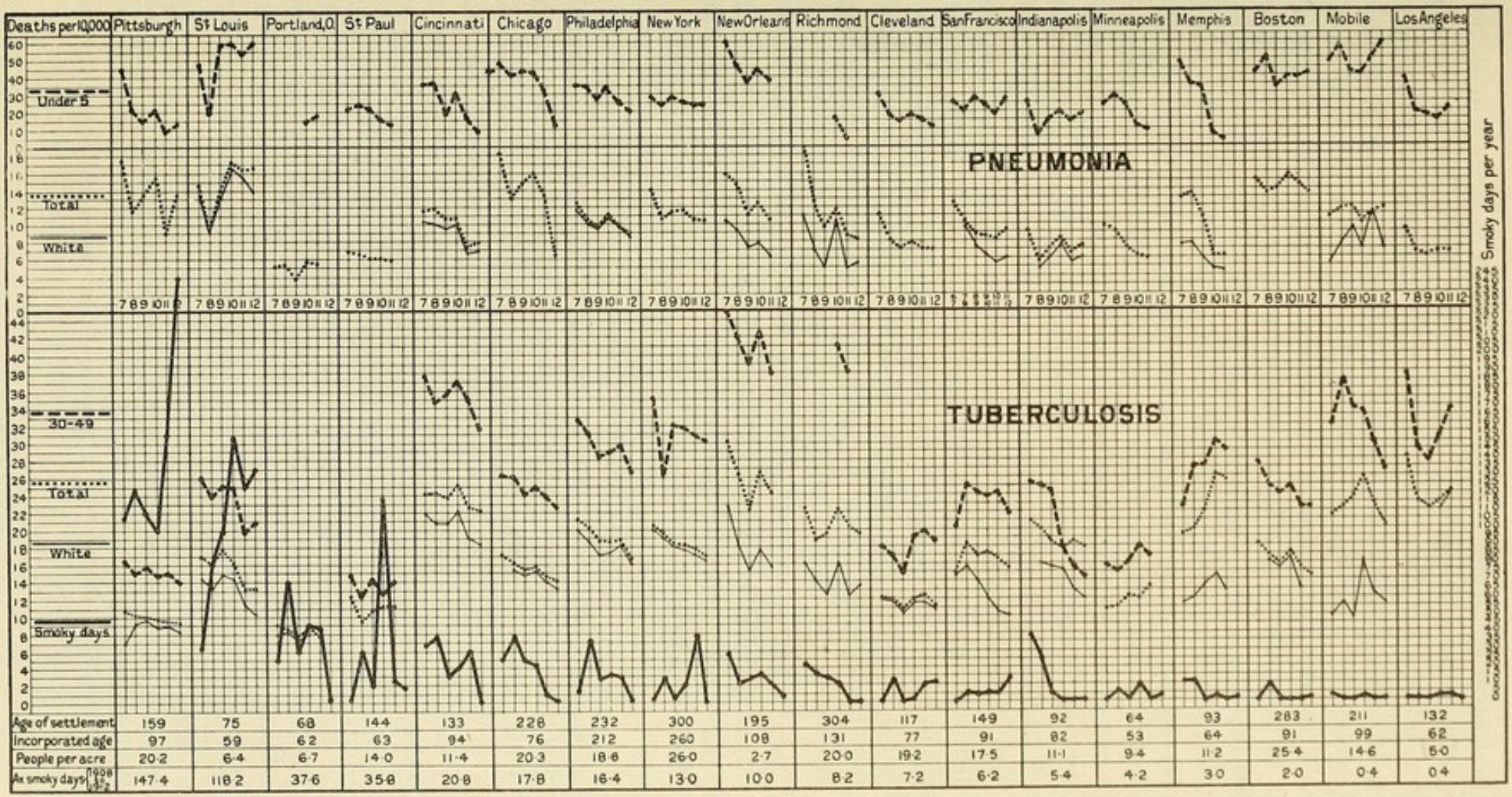
[1] Some six hundred years ago, the citizens of London petitioned King Edward I to prohibit the use of "sea coal." He replied by making its use punishable by death. This stringent measure was repealed, however, but there was again considerable complaint in Queen Elizabeth's reign, and the nuisance created by coal smoke seems to have been definitely recognized at this period. Since this time there has been continual agitation, together with much legislation, both abroad and in this country. In the seventeenth century, King Charles II adopted repressive measures in London, and in the present century anti-smoke crusades have been frequent. In fact, the smoke problem will undoubtedly continue to demand attention until it is either



	Pittsburgh	St Louis	Portland,O.	St Paul	Cincinnati	Chicago	Philadelphia	New York	New Orleans	Richmond	Cleveland	San Francisco	Indianapolis	Minneapolis	Memphis	Boston	Mobile	Los Angeles
Age of settlement	159	75	68	144	133	228	232	300	195	304	117	149	92	64	93	283	211	132
Incorporated age	97	59	62	63	94	76	212	260	108	131	77	91	82	53	64	91	99	62
People per acre	20·2	6·4	6·7	14·0	11·4	20·3	18·6	26·0	2·7	20·0	19·2	17·5	11·1	9·4	11·2	25·4	14·6	5·0
Av. smoky days 1908 to 1912	147·4	118·2	37·6	35·8	20·8	17·8	16·4	13·0	10·0	8·2	7·2	6·2	5·4	4·2	3·0	2·0	0·4	0·4

Death-rates per 10,000 for Pneumonia and Tuberculosis in Eighteen Cities, 1907-1912. The number of smoky days are noted for each year (heavy line). Total death-rates (dotted line). Age of settlement and population per acre noted.

The Lancet undertook by means of a system of gauges of its own design to estimate the annual deposit in London of all adventitious matter from the atmosphere. In the city proper it was calculated to be nearly five hundred tons to the square mile or about four and a half pounds per acre each day. Were it mere dirt it would not be so serious, but it is charged with gases and fluids of a deleterious character such as sulphates, chlorides, ammonia, and carbon that is more or less oily and tarry. One of the experts employed by the Meteorological Council in connection with the County Council of London, found that the sulphur contents of the coal ranged from one to two per cent and that from half a million to a million tons of sulphuric acid were diffused in the air every year. The loss to property from this erosive influence he estimated at about five and a half million pounds sterling. The effect upon health was a more elusive question, but stress was laid on the rise in death rate during foggy weather in which coal smoke plays a prominent part. Owing to the activity of the Coal Smoke Abatement Society, under the presidency of Sir William Richmond, atmospheric conditions are greatly improved, and it is claimed that there is a steady diminution in the number and density of the black fogs.

In an article on London as a Health Resort and as a Sanitary City, by S. D. Clippingdale, M. D., Trans. Royal Society of Medicine, February, 1914, there is an interesting historical account of London air and fog, with a bibliography.

CARBON DIOXIDE

Parallel conditions are observed in cities like Leeds, Liverpool, Manchester, and Glasgow, and in less degree in cities like Pittsburgh, Cincinnati, Chicago, Cleveland, and St. Louis, during periods of comparatively calm, and of heavy and humid atmosphere. Egbert[1] states that "it has been calculated that for every ton of coal burnt in London something like three tons of carbon dioxide are produced," and as the city's coal consumption is over 30,000 tons per diem, its atmosphere must receive the enormous daily contamination of about 300 tons of soot and 90,000 tons of carbonic acid every day! How important, then, the adoption of practical means to abate the smoke nuisance! Engineers assure us that such means

entirely solved by the abolishment of the use of solid fuel or by the installation of devices and methods which shall prevent the formation of smoke in furnaces, regardless of the nature of the fuel.

[1] Seneca Egbert: A Manual of Hygiene and Sanitation, Philadelphia, 1900. p. 74.

are perfectly feasible and economical. It does not need an engineer to assure us that they are hygienic.

Prof. Charles Baskerville, of the College of the City of New York, has vigorously attacked the problem of smoke and other air impurities. He shows[1] that the sticky properties of soot are due to the tar contained in it. This tar adheres so tenaciously to everything that it is not easily removed by rain. In large manufacturing districts, particularly in those where bituminous coal is used as fuel, vegetation is blackened, the leaves of trees are covered and the stomata are filled up, thus inhibiting the natural processes of transpiration and assimilation. In addition, the soot is frequently acid and the deposition of acid along with soot is probably one of the principal causes of the early withering which is characteristic of the many forms of town vegetation.

SULPHUR DIOXIDE

Aside from the solid material which pollutes the atmosphere of cities, there are correspondingly enormous quantities of noxious gases which are equally injurious to persons with tubercular disease or other diseases of the respiratory tract. Mention has already been made of the vast amounts of carbonic acid gas generated by furnaces, not to speak of the quantities exhaled by human beings. The production of this carbon dioxide by the combustion of coal offers a definite measure of the production of sulphur dioxide. These two gases have the same origin and the measure of one is the measure of the other. Recent studies by Prof. Theodore W. Schaefer, who has made many observations of the air of Kansas City during fogs, tend to show that the presence of sulphur dioxide has an unfavorable effect on persons suffering from bronchitis, pharyngitis, pneumonia, and asthma. In January, 1902, the heavy fogs occurring in St. Louis, Missouri, caused serious injury to the throat and lungs of prominent singers and in an action brought against the city and its chief smoke inspector, it was alleged that owing to the additional presence of smoke, suffocating gases, and acid, the health of the complainant was injured. In a mandamus proceeding it was asked that the authorities be compelled to abate the smoke nuisance.

Prof. Schaefer has used the data mentioned previously as to the output of carbonic acid in London and states that he finds that at least 2,700 tons of sulphur dioxide are generated daily in that city and pass into surrounding atmosphere. This gas, after uniting with

[1] Medical Record, New York, November 23, 30, 1912.

the oxygen and aqueous vapor of the air, is converted into sulphuric acid.[1]

The presence of sulphur in coal, or in iron pyrites contained in coal, is responsible for this acid product and Prof. Schaefer believes that sulphur dioxide, being a very heavy gas, with a specific gravity of 2.25, is alone capable of creating a fog, or is at once shown when it is brought in contact with the atmosphere, from which it absorbs aqueous vapor, causing dense, heavy fumes. The dust or carbon particles, coming in contact with this acid vapor, enhance its gravity materially.

Prof. Baskerville some time ago made a number of determinations of the sulphur dioxide content of the air of New York city. Stations were established throughout greater New York city, including high office buildings, parks, subways, stations, and railroad tunnels; and very variable results, as might be expected, were obtained. The determinations may, in part, be thus summarized:

Locality	*SO_2 in parts in a million*
Elevated portion of city, near a high stack	3.14
Various parks	0.84 (maximum; others negative)
Railroad tunnels	8.54—31.50
Subway	None
Downtown region	1.05—5.60
Localities near a railroad	1.12—8.40

In 1907, the residents of Staten Island, as well as some on Long Island, complained of the noxious nature of the air wafted over from various plants in New Jersey. This induced the Department of Health of the City of New York to investigate the air and vegetation in the vicinity of the Borough of Richmond, Staten Island, and some of the results obtained are given below by permission of the Department.

Substance	*Impurity*
Air	Trace of sulphuric acid
Air	0.0066 per cent. SO_2 by weight
Air	Trace of sulphuric acid
Grass (three samples)	Sulphuric acid present
Grass	0.24 per cent SO_3
Grass	0.70 per cent SO_3
Leaves	0.19 per cent SO_3
Leaves	0.28 per cent SO_3
Soil	0.0015 per cent SO_3

[1] Theodore W. Schaefer: The Contamination of the Air of our Cities with Sulphur Dioxide, the Cause of Respiratory Disease. Boston Medical and Surgical Journal, July 25, 1907.

These results do not really give us anything definite, as the comparative factor is absent.

Fog usually collects in the lower portions of a city, especially in depressed localities known as hollows, where it remains until dispersed by air currents. The well-known increase of mortality in cities during the continued presence of heavy fog with these additional contaminations have been recorded and commented upon for years. The heavy, suffocating, poisonous quality of sulphur dioxide is well known and has been the subject of several investigations. In general, it may be said that the chief symptoms of poisoning with sulphurous acid are those of irritation of the mucous membranes. Even in five parts in 10,000 it acts as an irritant, causing sneezing, coughing and lacrymation, bronchial irritation and catarrh (Cushny). It is also credited with causing pneumonia and Prof. Schaefer notes its power to produce asthma.[1] Undoubtedly it would aggravate pulmonary and laryngeal tuberculosis and either delay or prevent a cure under the conditions described.

AMMONIA IN THE AIR

This gas is constantly present in the atmosphere, but in very minute quantities. Fifty years ago Boussingault and, later, Schloesing made careful investigations of this impurity of the atmosphere and devised ingenious methods of estimating its amount in air and rain water. It usually exists only in combination with carbonic or nitric acid; very little is free. Water absorbs it freely and it has been estimated that in France the annual rainfall brings to the earth in the form of nitrogen nearly 5 kilograms per acre. The presence of ammonia indicates organic putrefaction. Its amount does not usually exceed a very few parts per million. It is usually perceptible, as we all know, in and about stables.

As far as any relation to tuberculosis is concerned, ammoniacal air has for us only a remote interest. At one time it was strongly advocated as a cure for pulmonary consumption and perhaps some historic details may be of interest here.

Dr. Thomas Beddoes, of London, published in 1803, "Considerations on a Modified Atmosphere in Consumption Cases," and strongly advocated residence in a cow stable for such cases. One of his patients was Mrs. Finch, a daughter of Dr. Joseph Priestley,

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[1] This accords with the conclusions of W. C. White and Paul Shuey, *loc. cit.* The relation of Sea Fog to Tuberculosis is considered in the next chapter, page 52.

famous for his epoch-making discovery of Oxygen. The patient, from the description given, had a well-marked case of pulmonary tuberculosis in the second or third stage. She was placed in a stable 14 by 20 feet and 9 feet high, and her bed was in a small recess a few inches above the ground of the stable, where two or three cows were kept. The temperature was maintained at 60° to 70° F. Mrs. Finch remained in this cow house nearly all the time from the autumn of 1799 until the spring of 1800. In a letter, dated August 15, 1800, the patient wrote, "I am happy in being able to say that my chest continues perfectly well; and from the difference of my feelings now, and some years back, I am more than ever a friend of the cows. I avoid colds and night air; and by rides in the country am anxious to brace myself against winter and the necessity of a sea voyage."

OXYGEN FOR TUBERCULOUS PATIENTS

Shortly after the discovery of oxygen, physicians were stimulated to try the effect of various gases in the treatment of phthisis. Fourcroy and Beddoes both observed the effects of the inhalation of oxygen and found that it accelerated the pulse and respiration, and, as they believed, increased inflammatory action so that they concluded that its effect was prejudicial. Beddoes held that in phthisis there is an excess of oxygen in the system and consequently, that free air was injurious to the patient. He says in the essay quoted previously:[1] "As it seemed to me hopeless to propose residence in a cow house, I advised that the patient should live during the winter in a room fitted up so as to ensure the command of a steady temperature. This advice was followed. Double doors and double windows were added to the bed room. The fire place was bricked up round the flue of a cast iron stove for giving out heated air." What a contrast to the fresh air cure of the present day! But the doctor persisted in his plan of treatment until the patient died.

The amount of oxygen present in the atmosphere, 20.938 per cent, is precisely adapted to the needs of animal life and the same proportion of oxygen is preserved in the atmosphere everywhere, without regard to altitude.[2] It has been found that animals die if the ratio of oxygen is artificially decreased by as much as twenty-five per

[1] Thomas Beddoes: Observations on the Medical and Domestic Management of the Consumptive. American edition, Troy, 1803, p. 42.

[2] Analyses by Gay-Lussac of Air Collected at 7,000 meters; and observations by Dumas and Boussingault.

cent; but Paul Bert[1] also showed that too much oxygen was equally prejudicial to life and, indeed, poisonous, animals dying in a super-oxygenated atmosphere as soon as their blood contains one-third more than the normal ratio of oxygen, because in such an atmosphere the hemoglobin of the red blood corpuscles is saturated with oxygen—a fact which never occurs under normal conditions—and a proportion of this gas then dissolves in the serum of the blood. Here lies the danger, for the tissues cannot withstand the presence of free, uncombined oxygen and death follows. The question immediately arises: Why do the tissues require combined oxygen and why does free oxygen kill them?. No one knows. Henry de Varigny, who deals with this subject with reference to ærobic and anærobic organisms deals with this curious fact and acknowledges our limited knowledge on this point. He states, however, that while a certain increase in the ratio of oxygen results in death, lesser increases of a temporary character may be beneficial. Every poison kills, doubtless, but there are doses which not only do not kill, but even confer benefit and improve health.

Lorrain Smith has shown that oxygen at the tension of the atmosphere stimulates the lung-cells to active absorption; at a higher tension it acts as an irritant, or pathologic stimulant, and produces inflammation.[2]

As far as the respiratory processes are concerned the respiration of pure oxygen takes place without disturbing them for even in an atmosphere of pure oxygen animals breathe as though they were respiring normal atmospheric air.[3]

Sir Humphrey Davy believed that when pure oxygen was inspired there is no more chemical change induced than occurs when atmospheric air is breathed; in other words, let the vital actions be a constant quantity, the addition of oxygen to the inspired air does not materially increase vital transformation. Fifty years ago there was great confusion in the minds of otherwise intelligent observers and false reasoning led them into grave errors. Those who, like Beddoes, believed that there was too much oxygen in the system held that the inhalation of air containing carbonic acid was the proper plan of treatment and this theory of hyper-oxidation was revived

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[1] Paul Bert: La Pression Barometrique, 1878.
See also monograph by F. G. Benedict quoted on page 31.

[2] Lorrain Smith, in Journal of Physiology, 1899, Vol. 24, p. 19.

[3] An American Text Book of Physiology, Vol. 1.

by Baron von Liebig, who recommended that in phthisis the respiratory action should be lessened.[1]

The Boston Nutrition Laboratory of the Carnegie Institution of Washington has undertaken a most painstaking series of investigations bearing on this subject. They include an examination of the comparative oxygen-content of uncontaminated outdoor air under all conditions as to wind direction and strength, temperature, cloud formation, barometer, and weather. In addition, samples of air were collected on the Atlantic Ocean, on the top of Pike's Peak, in the crowded streets of Boston, and in the New York and Boston subways. The results of the analyses of uncontaminated outdoor air showed no material fluctuation in oxygen percentage in observations extending over many months and in spite of all possible alterations in weather and vegetative conditions. The average figures are 0.031 per cent of carbon dioxide and 20.938 per cent oxygen. The ocean air and that from Pike's Peak gave essentially similar results.

The extraordinary rapidity with which the local variations in the composition of the air are equalized is accentuated by the observations on street air in the heart of the city, where the contaminating factors might be expected to be of sufficient magnitude to affect perceptibly the analytic data. Only the slightest trace of oxygen deficit is shown, with a minute corresponding carbon-dioxide increment. Observations such as these tend to demonstrate the extent of the diffusion of gases and the establishment of equilibrium by air-currents.

Most unexpected are the figures in regard to the extremely small extent to which the air was vitiated in the modern "tube" or subway, even during "rush" hours. There was, on the average, a fall of 0.03 per cent in oxygen accompanied by a rise of 0.032 per cent in the carbon dioxide. Professor Benedict points out that while the measurement of carbon dioxide has been taken as an index of good or bad ventilation, the fact that the proportion of oxygen is actually lowered by an increase in the carbon dioxide has never before been clearly demonstrated. As a result of this, the determination of the content of carbon dioxide in the air, which can be made with ease and accuracy, suffices to establish the approximate percentage of oxygen. For every 0.01 per cent increase in the atmospheric carbon dioxide one may safely assume a corresponding decrease in the percentage of oxygen. Aside from minor fluctuations ex-

[1] See Edward Smith: Consumption, Its Early and Remediable Stages. Blanchard and Lea, Philadelphia, 1865.

plained above, it may now truly be said that "the air is a physical mixture with the definiteness of composition of a chemical compound."[1]

Since the introduction[2] into medical practice of oxygen compressed in cylinders its use has been tried in tuberculous cases, but no satisfactory results have been obtained and its use is discontinued, except, so far as we know, in the hands of charlatans.

The inhalation of oxygen gas may not *per se* exert any curative action on a tuberculous lung, but that fact should not lead us to the conclusion that the voluntary respiration of an increased quantity of air is not beneficial. It is stated that the air in the central parts of the lungs is richer in carbonic acid than that found in the larger tubes and hence deep inspiration followed by deep expiration causes a larger amount of the air richer in carbonic acid, to be exhaled. From this the conclusion is drawn that increased chemical change will result, for if the carbon dioxide be removed from the air cells its place will be filled by quantities of the same gas which will escape from the blood. Furthermore, the removal of carbon dioxide from the blood facilitates and makes possible those metabolic changes which with a supply of suitable food improve nutrition.

Nowadays we often speak of oxygen as synonymous with atmospheric air and in this sense we give it a prominent place in pulmonary therapeutics. We are tempted to reproduce the placard of an old boot-maker and chiropodist of fifty years ago which read:

> The best medicine! Two miles of oxygen three times a day. This is not only the best, but cheap and pleasant to take. It suits all ages and constitutions. It is patented by Infinite Wisdom, sealed with a signet divine. It cures cold feet, hot heads, pale faces, feeble lungs and bad tempers. If two or three take it together it has a still more striking effect. It has often been known to reconcile enemies, settle matrimonial quarrels and bring reluctant parties to a state of double blessedness. This medicine never fails. Spurious compounds are found in large towns; but get into the country lanes, among green fields, or on the mountain top, and you have it in perfection as prepared in the great laboratory of nature.
>
> Before taking this medicine . . . should be consulted on the understanding that corns, bunions, or bad nails, prevent its proper effects.

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[1] See the recent monograph by Benedict, F. G.: The Composition of the Atmosphere with Special Reference to Its Oxygen Content, Carnegie Institution of Washington, Publication 166, 1912. Review in Journ. Amer. Med. Ass., Jan. 25, 1913.

[2] The late Dr. Andrew H. Smith, of New York, was the first in the United States to use Oxygen in medical practice, 1860. "Oxygen gas as a Remedy in Disease," A. H. Smith, 1870.

The old London boot-maker had more wisdom than most of the doctors of his time.

CHAPTER III. INFLUENCE OF SEA AIR; INLAND SEAS AND LAKES.

SEA VOYAGES

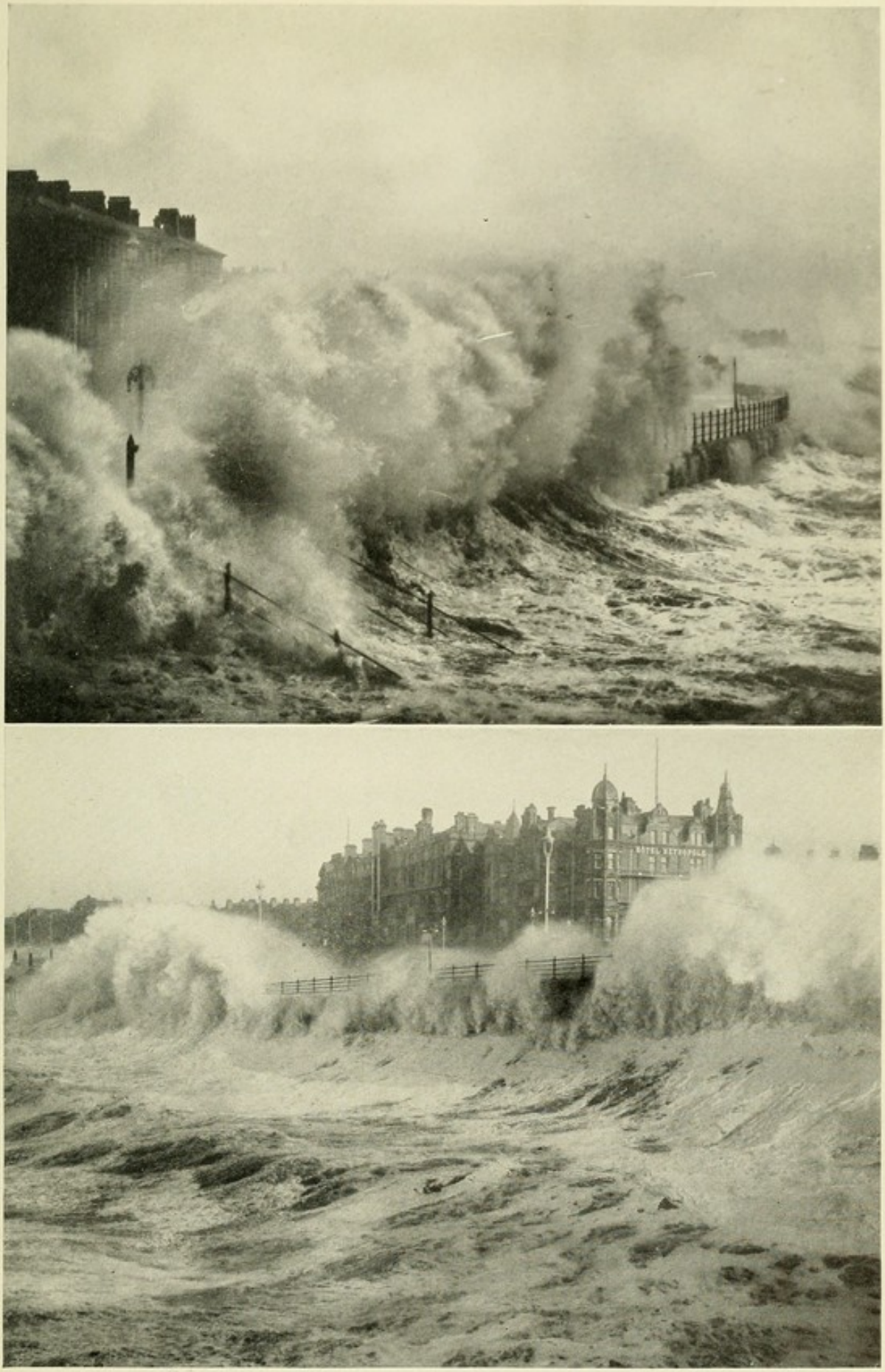
The value of sea air in tuberculosis has been discussed *pro* and *con* for ages and, like the tide, there is an ebb and flow of sentiment regarding its value in the treatment of tuberculosis. Undoubtedly there is, at present, a stronger belief in the efficacy of sea air in the various forms of tuberculosis than at any previous time. This is especially true as regards tuberculosis of the bones, the tuberculosis of children and in the important class of cases termed fibroid phthisis.

Aretaeus, about 250 B. C., recommended sea voyages for the cure of consumption, and 300 years later Celsus advocated voyages from Italy to Egypt, if the patient were strong enough. Celsus was a layman whose learning was truly encyclopedic, but only his medical writings have survived. When the Roman sufferer from tuberculosis was not able to make the sea voyage to Egypt he was sometimes advised to pass a large portion of his time sailing on the Tiber.[1]

At Kreuznach, Ems, and other continental resorts, salt inhalations are given to patients with scrofulous and chronic bronchial affections. Instead of trusting to sea breezes the patients are taken to halls where saline particles are present in a higher precentage than they can ever be at the sea side. They inhale the salt-laden air and make use of pulverization apparatus. Hours are spent in the open air near the "evaporating fences" so as to inhale salt air at interior stations. At Ems this treatment is carried out in pneumatic chambers capable of holding ten people in compressed atmosphere for about 1¾ hours.

Sea air is of acknowledged purity as to micro-organisms, dust and adventitious gases. As previously remarked, there is at sea a maximum of ozone and a minimum of all foreign deleterious substances. (See page 9.) Without considering, as yet, the amount of watery vapor in the air of the ocean and other features of ocean air such as its movement and temperature, we recognize some physical contents such as a minute quantity of sodium chloride, iodine and bromine as characteristic of sea air when contrasted with air from any other

[1] "Opus est, si vires patiuntur, longa navigatione, coeli mutatione, sic ut densius quam id est, ex quo discedit aeger, petatur; ideoque aptissime Alexandriam ex Italia itur." Celsus, De Med. lib. III, Cap. 22.



STORM AT BLACKPOOL, ENGLAND. SHOWING HOW SALINE PARTICLES ENTER THE ATMOSPHERE
Photographs by Courtesy of Dr. Leonard Malloy

locality. The wind carries aloft fine particles derived from the crests of the waves and this saline matter from sea water and foam is constantly present near the surface and is carried for miles inland.[1] It is well known that plants near the seashore have a perceptible coating of saline matter which modifies their growth.

As far as the present subject is concerned we have to deal with the influence on the tuberculous processes exerted by a marine climate. This can be obtained by undertaking sea voyages or by a residence on islands, or on the seaboard.

Ocean voyages were formerly strongly advocated as a means of cure in tuberculosis and were given an extended trial especially by English physicians. The constant commercial intercourse between England and her possessions all over the world made the practice easy and the results have been carefully weighed. Before the days of steam the typical ocean voyage from London to China or India involved vastly different conditions, as to time, route and accommodations. Some features will always be the same. Seasickness, the confined air of cabins, storm and wet will remain to harrass and terrify the traveler. But the clipper ships of the past are now, for the most part, doing duty as coal barges and the steam "tramp" and ocean liner carry the cargoes of the world.

After ruling out the tramps, cattle ships, and the coasting schooners, we have left a few sailing vessels still engaged in the East India trade and the fast liners. Modern systems of ventilation and cold storage have corrected some of the great disadvantages of the past and the presence of competent surgeons on board all the larger passenger steamers make the trip comparatively safe for a tuberculous patient if the necessity arises for him to make the voyage. But as a strictly therapeutic measure such trips are not to be recommended and in this we are supported by nearly all good authorities.[2]

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[1] Two illustrations from a storm at Blackpool, England, are supplied by the courtesy of Dr. Leonard Molloy.

[2] Huggard, A., Handbook of Climatic Treatment, London, 1906, says: "Sea voyages were formerly in great repute for persons with phthisis; but it is now recognized that, except in certain well-defined instances they generally do harm. Only slight or mild cases without fever and without active symptoms, are likely to benefit. The patients most suitable for a sea voyage are those in whom the disease has become partly or entirely arrested." Dr. Burney yet doubts whether phthisis at any stage is benefited by ocean travel. Prof. Charteris, of Glasgow, approves of a sea voyage in the early stage of phthisis in a young person, but after that stage all experience testifies that degeneration proceeds more rapidly on sea than on shore and the patient, if he reaches land, only does this to find a grave far away from the surroundings of friends and home.

Dr. W. E. Fisher, for many years surgeon to the Pacific Mail Steamship Co., while observing that patients affected with chronic diseases, such as phthisis, dyspepsia, etc., are not so liable to seasickness as others, states that a large percentage of tuberculous patients stand the sea voyage badly. Dr. Fisher's experience relates to the trip from New York to San Francisco by way of Panama. During the first part of the voyage until the Bahama Islands are reached, the invalid experiences bracing weather. From that point to the Isthmus and thence up the coast during the long voyage of three weeks or more, a distance of nearly three thousand miles, the temperature averages 90° in the shade and on many days rises as high as 95° or 96° F. This occurs during the winter months and is the direct cause of deaths on the voyage or shortly after arrival on the California coast.

Dr. R. W. Felkin, of Edinburgh, says:[1] "Fifteen years ago I used to advocate sea voyages in my lectures on Climatology in Edinburgh, with great confidence; now I am more cautious. I do not send phthisical patients to sea as I once did. The risk of spreading infection is, to my thinking, too serious to be incurred. I well remember once sending two sisters to Australia; the elder suffered from phthisis; the younger was healthy. The elder certainly did gain some temporary benefit, but the younger sister and also a cabin companion became infected, and all three girls were in their graves within a year of their return to this country. I am sure that occupying a joint cabin as they did caused the mischief."

Dr. F. Parkes Weber, of London, takes a more hopeful view.[2] He says that sea voyages are often useful in the milder and quiescent forms of pulmonary tuberculosis, provided the patient's general condition be such as otherwise to fit him for life on shipboard. "Long voyages are to be preferred to all other methods of treatment in the case of male patients who have a taste for the sea, who are strong physically, or who possessed an originally strong constitution and were infected by 'chance' or when weakened by overwork, worry, improper hygienic conditions, or acute diseases."

In pulmonary tuberculosis complicated by syphilis, or syphilitic phthisis, as it was formerly designated, a marine climate seems to be particularly suitable.[3]

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[1] Journal of Balneology and Climatology, January, 1906.

[2] F. Parkes Weber: System of Physiologic Therapeutics, Vol. 3, p. 87, Philadelphia, 1901.

[3] See Roland G. Curtin, Trans. Amer. Climatological Ass., Vol. 4, p. 31.

The vicissitudes of sea-travel, the narrow cabins and the difficulty of obtaining a suitable diet, even such common requisites as milk and eggs, should be enough to condemn this plan. Tuberculosis patients ought not to travel more than is absolutely necessary. Imagine the bacteriological condition of a consumptive's stateroom, for instance, at the end of a month's voyage! What sea-captain or steward would ever put such a cabin into a sanitary condition for the next passenger?

The author has some experience of life at sea under both sail and steam, although he has never taken very prolonged voyages. Taking into account the character of the food supply and the necessity of at least sleeping in small cabins and probably spending days in them, with uncertain medical attention; and, besides this, the dangers of various kinds that pertain to seaports, the author feels bound to condemn sea voyages for the tuberculous in any stage.

"Non mutant morbum qui transeunt mare."

MARINE CLIMATE OF ISLANDS

It is far better for the tuberculous patient to remain on *terra firma* than to traverse the sea. Whatever is of value in the sea air can be obtained in islands such as Ireland, the Isle of Man, the Isle of Wight, Nantucket, the Isles of Shoals, Newfoundland, Long Island, the Bahamas, the Canaries, the Philippines, Samoa, and many other islands.

Just as in the case of sea voyages, there are concomitant influences, many of which are notoriously unfavorable, that in themselves over-balance any possible advantage from sea air. Take, for instance, the problem as it presents itself in Ireland or the Isle of Man.

Among the various countries of the world Ireland stood fourth in the order of mortality from tuberculosis, being exceeded by Hungary, Austria, and Servia. During the last thirty-five years the mortality in Great Britain has been reduced one-half among females and one-third among males but, until 1907, there had been no such fall in Ireland.

Sir John Byers, of Belfast, in his address[1] entitled "Why is Tuberculosis so Common in Ireland?" characterized its prevalence in that country as "appalling." Among the nine causes which are assigned for this condition of affairs attention is first directed to the *damp climate*. An investigation of places with rather worse con-

[1] The Lancet, January 25, 1908. See also Alfred E. Boyd, M. B.: Tuberculosis and Pauperism in Ireland, British Journ. Tuberculosis, July, 1908, p. 159.

ditions of climate led Sir John to say on this point: "I cannot, therefore, admit that there is much in the dampness of the atmosphere as a cause of tuberculosis in Ireland." Sir William Osler takes precisely the same ground and pointed out at the opening of the Tuberculosis Exhibit in Dublin, that Cornwall, with a much damper atmosphere than that of Ireland, was so free from the disease that consumptives were sent there. In Cardiff, Wales, with a damp climate and with the ground water in many places near the surface in the gravel and with the lower part of the town on a stiff marine clay, very retentive of moisture, the tuberculosis death rate for 1906 was only 1.20 per 1,000. On the other hand in Belfast, with a smaller rainfall (34.57 inches as against 42.43 inches) the mortality was more than twice as much, or 2.77 per 1,000. The figures for 1906 were:

	Rainfall inches	Death rate from tuberculosis per 1000
Manchester, notoriously damp, foggy and smoky	....	1.82
Liverpool	....	1.82
London	....	1.42
Cardiff, Wales	42.81	1.20
Bolton, England	42.43	1.11
Belfast, Ireland	34.57	2.77
Cork	....	4.53
Dublin, Ireland	27.73	2.91
North Dublin, Ireland	....	4.70

After taking up in turn dampness of soil, emigration as a cause for tuberculosis, the asserted susceptibility of the Irish to tuberculosis, poverty and social position, food and drink and industries, and after weighing them carefully they were all discarded as insufficient causes of this mortality. The prime cause was declared to be *want of Sanitary Reform* and the *prevalent domestic or home treatment of the advanced cases of pulmonary tuberculosis.*

Since 1907 an encouraging decline in the mortality from tuberculosis has been noted. Whereas the rate for both sexes throughout Ireland was 273.6 per 100,000 in 1907 it had dropped by gradual stages to 215.2 in 1912. Sir William Thompson, the General Register for Ireland, justly attributes this well marked decrease during the past six years to the exertion of Her Excellency, the Countess of Aberdeen.[1]

[1] Trans. National Association for the Prevention of Consumption and Other Forms of Tuberculosis, 5th Annual Conference, London, August 4 and 5, 1913. See also Sir John Moore, Interstate Medical Journ., April, 1914.

Sir William shows that this decrease indicates 17,000 fewer people suffering from tuberculosis in Ireland in 1912 than there were in 1907. This corresponds to a decrease of nearly one-fifth of the total number of cases of tuberculosis. He seems hopeful that within the next few years the death-rate from tuberculosis in Ireland will not be above the average in other countries.

Undoubtedly hygienic and philanthropic measures are entitled to the credit for this marked improvement and it gives us pleasure to note in this connection the remarkable work of Her Excellency, the Countess of Aberdeen. This noble woman founded in 1907 the Women's National Health Association of Ireland and a vigorous campaign was started which soon roused the whole country to a sense of responsibility in matters of public health and, in particular, to measures necessary for the prevention and cure of tuberculosis. The influence of this organization rapidly spread and within eighteen months no less than seventy branches had been opened throughout Ireland, for the most part opened in person by their excellencies, the Lord Lieutenant and Countess of Aberdeen, and now it has 150 branches and 18,000 members.

While undertaking the reduction of infant mortality, the improvement in the milk supply and better school hygiene, the association made a systematic attack on the prevalence of tuberculosis. This included home treatment and its strong ally, the tuberculosis dispensary, on a plan similar to that originated by Sir Robert Philip, of Edinburgh; it included sanatorium treatment; and it provided special treatment for advanced cases of tuberculosis. In this phase of the work the association had the benefit of £145,623. through the provisions of the National Insurance Act. Charitable Americans also contributed handsomely toward the erection of sanatoria now comprising one thousand beds, the maintenance of dispensaries and of depots for the supply of pasteurized milk.[1]

It is interesting to note that the Association also lent its support to the formation of an "Irish Goat Society," believing that the best way to meet the scarcity of milk experienced in many parts of Ireland is to encourage the keeping of a good breed of milking goats. Then, too, through the administration of the Laborer's Acts nearly fifty thousand cottages with garden plots ranging up to one acre have been built for rural laborers by rural sanitary authorities at an outlay of over £8,000,000.

We have cited this remarkable campaign of the anti-tuberculosis

[1] The late Mr. R. J. Collier and Mr. Nathan Straus.

movement in Ireland to show how close are its relation to the broader field of general hygiene and sanitation and to show that such work pays; and furthermore what great service one person of noble birth, by her foresight, solicitous care and untiring devotion, can initiate and carry out. As Prof. Thompson says: There is no doubt that it will rank as one of the greatest philanthropic efforts of our time.

Take the Isle of Man. This island in the Irish Sea has a population of over ten thousand and for six hundred years has been singularly free from the admixture of English, Irish, or Scotch blood. The island has a more equable climate than any other part of the British Isles. The mean annual temperature is 49° F. There is comparative absence of frost, fog, or snow. But careful records since 1880 show that the Manx tuberculosis death rate is about double that on the mainland.[1]

	1880-82	1883-1897
Isle of Man	31.63	25.70 per 10,000
	1887	1893
England and Wales	15.08	13.07 per 10,000
	1888	1894
	14.28	12.17 per 10,000
	1889	1895
	14.35	12.43 per 10,000
	1890	1896
	15.06	11.39 per 10,000

The Bahamas and Bermuda in the Atlantic Ocean have a subtropical marine climate that experience shows to be far too relaxing and enervating for tuberculous patients.

The Philippines and all other tropical islands are likewise entirely unsuited for tuberculous patients for the same reasons.[2] Newfoundland, with a harsh, damp, colder air, is equally bad.

Dr. Newsholme, of Brighton, President of the Epidemiological Section of the Royal Society of Medicine, in an elaborate inquiry into the principal causes of the reduction of the death rate from phthisis in different countries, came to the conclusion that the one

[1] Charles A. Davies, M. D.: Tuberculosis in the Isle of Man (Tuberculosis, London, Oct., 1900).

[2] According to Dr. Issac W. Brewer, U. S. A., "Notes on the Vital Statistics of the Philippine Census of 1903," American Medicine, Oct., 1906, the death rate from tuberculosis is one-third that in the United States.

common factor present in all cases where a fall was noted was the segregation of the patients in hospitals or sanatoria. In each country where the institutional has replaced the domestic relief of destitution there has been a reduction of the death rate from phthisis which is roughly proportional to the change.

As to the cause, then, of the spread of tuberculosis, we shall find that it probably always lies in ignorance, indifference and other moral or sociologic causes, and, in many of the cases cited, not to climatic or atmospheric conditions.

Our opinion of sea air is fortunately not confined to that of the high seas or even that of islands. The sea air sweeps the mainland and, as we know, modifies the climate of all adjacent portions of the Continent. The great source of atmospheric moisture is found ultimately in the oceans. The invisible watery vapor and the visible clouds are carried inland and deposit their water over the Continent. The monsoons which are most highly developed in India and other parts of Asia, prevail also in Texas and on the Pacific coast of the United States. These seasonal winds are of great importance from a climatic standpoint and hence should be taken into account in reference to the climatic treatment of tuberculosis.[1] During the summer and autumn in India these seasonal winds sweep inland from the sea and deluge the country with rain. This amounts, in the Khasi Hills, 200 miles north of the Bay of Bengal, to between 500 and 600 inches a year and reaches its maximum at points about 1,400 meters, 4,600 feet, above sea level.

Fortunately in the United States these seasonal winds, while present, are not so dominant as climatic factors. We are more concerned in the present study with the diurnal winds of the seashore. The sea breeze which tempers the heat of our coasts is a distinctly beneficial feature of the shore and not only tends to moderate the heat of the summer day, but sweeps inland for fifty or a hundred miles the pure ocean air and provides all the desirable features of a marine climate.

ARCTIC CLIMATE

Passing still farther north we have the Arctic climate. It is marine or insular and cold. Arctic voyages have been proposed for the treatment of tuberculosis and, as adjuncts to the voyage, a summer sojourn in the northern fjords of Greenland. A trip of this

[1] See William Gordon: The Influence of Strong, Rainbearing Winds on the Prevalence of Phthisis, H. K. Lewis, London, 1910, Observations in Devonshire.

kind has been seriously planned by Dr. Frederick Sohon, of Washington, D. C., but has never yet been carried out.[1]

It is a significant fact that Arctic explorers from Dr. Elisha Kent Kane down, including General A. W. Greely, Admiral Peary, Mr. W. S. Champ, Mr. Herbert L. Bridgman, the late Dr. Nicholas Senn, and others comment on the healthfulness of the Polar climate. Dr. Sohon made two voyages with Commander Peary, in 1896 and in 1902, and states his opinion that in summer the Arctic regions are entirely suitable for, and beneficial to, the tuberculous, and that the unequaled natural advantages for a cure can be practically utilized. Few understand the fascination which the Polar regions undoubtedly exert on all who enter that charmed circle. The expressions used by Arctic explorers seem so extravagant to the average mind. The late Professor Senn says: "Nature there lends such efforts toward prophylaxis, as to leave no need for therapeutics."[2]

The air of the Arctic regions is free from dust and germs. It is not, in itself, responsible for any disease which may be carried into Arctic settlements by ships' crews, or by means of the migration of animals or birds. Colds and catarrhal conditions are conspicuously absent. There is no pneumonia. The only "Arctic Fever" is that which explorers are almost sure to contract on their first visit and which has an annual periodicity. It is not a self-limited disease, as Admiral Peary can testify after nearly fourteen consecutive summers in the Polar regions.

Another feature of the atmosphere in the Arctic is absolute clearness and abundance of sunshine. Dr. Sohon, in 1902, exposed dishes of agar and introduced into culture tubes pebbles, bits of vegetation and water from the ground and from pools at Commander Peary's winter quarters. Of six dishes exposed for from one-half to two hours, two were sterile and four gathered only a common white mould (P. glaucum). Only the hay bacillus was obtained from the pebbles. Water yielded the hay bacillus, *B. liquefaciens*, *B. fluorescens* and an unclassified non-pathogenic saprophytic rod organism.

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[1]Frederick Sohon, M. D.: Personal Observations on the Advantages of Certain Arctic Localities in the Treatment of Tuberculosis (American Medicine, April 23, 1904).

Idem. The Therapeutic Merits of the Arctic Climate Meteorological Data of a Summer Cruise (Journal American Medical Association, February 3, 1906).

[2]Nicholas Senn: Medical Affairs in the Heart of the Arctics (Journal American Medical Association, 1905, Vol. 45, pp. 1564, 1647).

The atmosphere has a bracing quality and is always credited with developing a prodigious appetite. It is pointed out that a taste is developed for the kind of food the tuberculous patient needs, viz., fatty food and meat. The craving for this kind of food is usually accompanied by a corresponding adaptability to digest it and, in healthy subjects, flesh is always gained. Dr. Sohon says that in both of his trips to Greenland he has exceeded his usual maximum weight, gaining the first time thirty pounds in two months, and the second time nineteen pounds in six weeks. In the latter voyage even the crew made an average gain of ten pounds in weight.

A large share of the beneficial influence of any atmospheric change is that which conduces to a good appetite and digestion. In this respect the summer Arctic voyage may fairly claim pre-eminence. With qualities such as these it is natural that, for a portion of the year at least, the merits of the Arctic climate in the treatment of tuberculosis should at least be considered.

An atmospheric feature is its great penetrability for light and especially for the actinic and ultra-violet rays. Tanning of the skin always occurs and sunburn is not uncommon. During summer the sun never sets and, though not very high in the heavens, its generous rays must exert a very beneficial influence on any morbid process, especially of a tubercular type. Arctic plants develop rapidly from seed to flower and seed again in surprising manner and the wild animals seem to be the largest and most vigorous of their kind.

In judging of the weather to be encountered in the Arctic regions, we are too much inclined to recall the harrowing accounts of the ill-fated expeditions of the past; but in the Northern fjords of Greenland, some miles from the coast, or in the protected inland bays, the atmospheric conditions of summer are quite agreeable and are especially suitable for the open air treatment.

The fluctuations of temperature are very moderate. The average minimum temperature between July 28 and September 6, between 69° and 78° north latitude on these Greenland Fjords, was about 38 F.; the average maximum was 49° to 50°. Temperatures as high as 56° were recorded at North Star Bay and about 52° at Etah.

The humidity averaged low. The records were made at 8 a. m. and 8 p. m., and, owing to the constant daylight, are much more representative estimates of relative humidity than in the case of records of relative humidity at those same hours in temperate latitudes.

	Maximum Humidity		Minimum Humidity		Average	
	8 a. m.	8 p. m.	8 a. m.	8 p. m.	8 a. m.	8 p. m.
New York	100	95	62	50	81.3	74.1
Denver	90	90	41	13	66.1	37.1
North Star Bay	72	71	56	39	63.1	54.
Etah, Greenland	81	70	40	35	57.6	52.4

The relative humidity was much lower while at anchor in the harbors of Northern Greenland than while en route through the Strait of Belle Isle and off Labrador and in Davis Strait and Smith's Sound.

We have given some attention to this subject on account of the very enthusiastic claims made on behalf of the atmosphere of the Arctic regions during summer treatment of tuberculosis. Although the plans for sending a ship with tuberculous passengers on this voyage failed to be carried out owing to inability to get the necessary permission from the Danish Government to land at the northern ports of Greenland, it is possible that at some future time the attempt will again be made.

The fact that Icelanders and Greenlanders may contract tuberculosis in numbers and may die from it is not to be overlooked; but the filth of winter quarters in the far North and the foul air of these huts is responsible for much of the illness of the native inhabitants. The Eskimo survives the dangers of the winter because he leads a totally different life in summer. It is difficult for those who have never been to the Polar regions to realize what a change is wrought by the advent of constant sunlight. This unique feature of the summer climate contributes to health and energy. The atmosphere, free from all germs and dust, bracing in its quality, is a strong stimulant to bodily functions as gain in weight testifies.

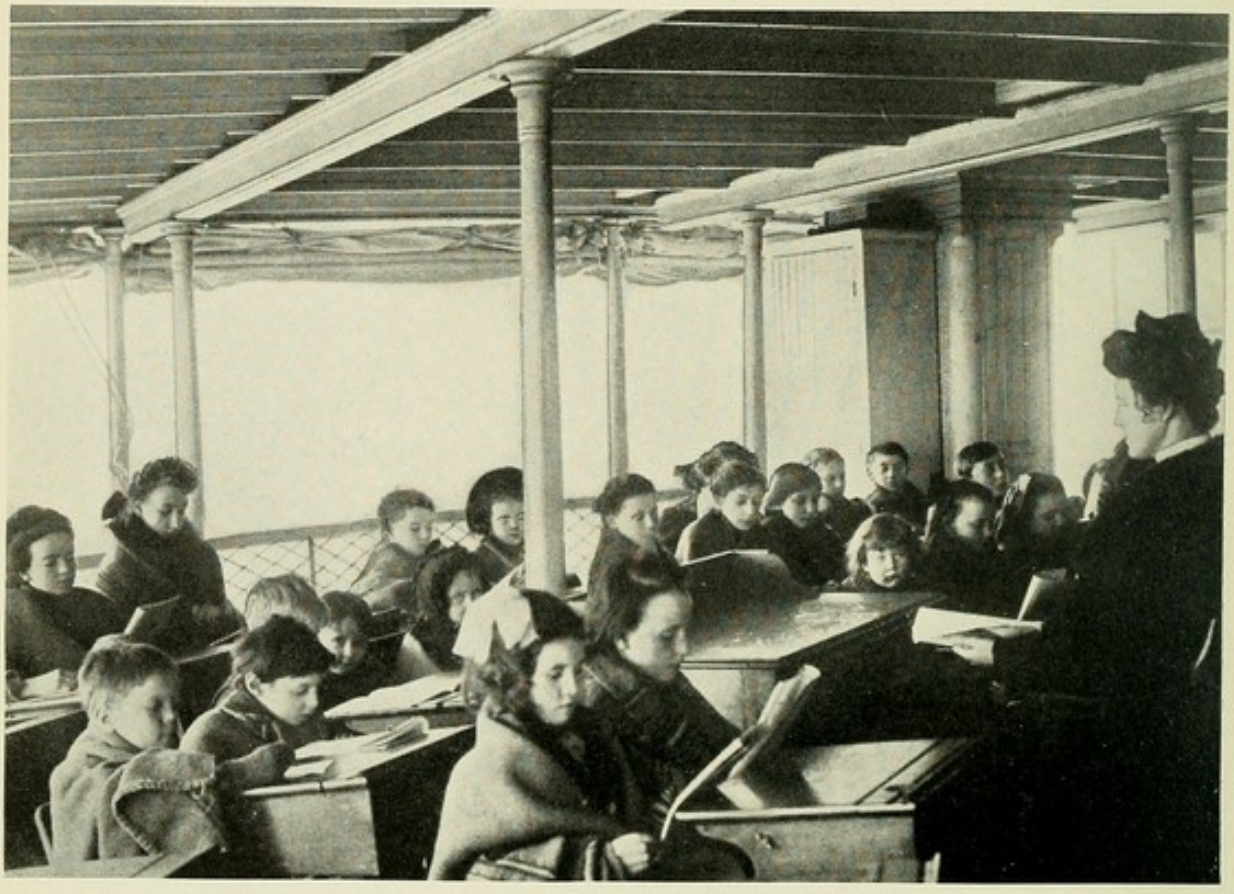
As a practical measure for the treatment of tuberculosis Arctic voyages have not yet been proved to be beneficial, although there is some presumptive evidence in their favor and, in view of the abundance of proof that the disease can be successfully combated at numberless places on the continent, such expeditions will scarcely meet with favor.

FLOATING SANATORIA

In 1896, Mr. M. O. Motschoutkovsky [1] advocated floating sanatoria for patients with incipient tuberculosis. These specially fitted vessels were to be shifted from port to port according to the season so as to get the most favorable climatic conditions.

[1] The Lancet, April 4, 1906, p. 939.

OPEN AIR CLASS ON FERRY BOAT "SOUTHFIELD," EAST RIVER, NEW YORK CITY. SLEEPING HOUR
Courtesy of Dr. J. W. Brannan



OPEN AIR SCHOOL FOR TUBERCULOUS CHILDREN. FERRY BOAT "SOUTHFIELD," BELLEVUE HOSPITAL. SEE PAGE 43

The vicissitudes of sea-travel, the narrow cabins and the difficulty of obtaining a suitable diet, even such common requisites as milk and eggs, ought to be enough to condemn this plan. Tuberculous patients ought not to travel more than is absolutely necessary. Old ferry boats have been recently utilized in New York as class-rooms for tuberculous scholars. The ferry boat "Southfield" has been equipped for this work through the Miss Spence's School Society under the direction and courtesy of Bellevue Hospital in cooperation with Dr. John Winters Brannan and Dr. J. Alexander Miller.

There are three classes on the "Southfield"; two for pulmonary cases of about thirty-six children; these classes being part of the regular Bellevue Clinic work and entirely supported by Bellevue.

The third class is for tuberculous cripples with about twenty children. The cost of nurses and special equipment for this class together with incidental expenses is borne by the Spence School Society.

The teachers for all three classes are supplied by the New York Board of Education so that they are a part of the regular school system.[1]

Owing to the fact that these old ferry boats seem to answer a useful purpose and in view of the reported use by the Italian Government of three discarded men-of-war as floating sanatoria in the treatment of tuberculous patients, a request was made to the Navy Department of the United States for similar ships by the Fourth International Congress on School Hygiene at Buffalo, N. Y., August 29, 1913, in a resolution, a portion of which is as follows:

> WHEREAS, It has been demonstrated in New York and other cities that discarded vessels lend themselves admirably to transformation into all-year-round hospitals and sanatoria for consumptive adults, sanatoria for children afflicted with joint and other types of tuberculosis, and into open air schools for tuberculous, anemic, and nervous children;
>
> *Resolved,* That the fourth International Congress on School Hygiene petitions the United States Government to place at the disposal of the various States of the Union as many of the discarded battleships and cruisers as possible to be anchored according to their size in the rivers or at the seashore and to be utilized by the respective communities for open air schools, preventoria, sanatorium schools for children, or hospital sanatoria for adults.

The Secretary of the Navy, however, for the following very good reasons, declined.

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[1] See Buffalo Medical Journal, 1907-8, Vol. 63, 41.

I am of the opinion that battleships are not suitable for floating sanatoria. This opinion is based on the following reasons.

The cost of maintaining a battleship in proper sanitary and structural condition is very high.

Battleships, particularly the older types, have very limited deck space, and this is so cut up by hatches, turrets, davits, cranes and winches that there are few spaces large enough for a cot. The cost of removing these obstructions would be equivalent to that of building more suitable floating hospitals.

The ventilation in the enclosed spaces of these vessels is so poor that it often has an unfavorable effect on those chosen especially for their health and vigor. Its effect on those already diseased could not be favorable. The openings are very small and admit but little sunlight; it is necessary to use artificial light for a large part of the day. To correct these conditions would involve great expense, even if it were possible of accomplishment.

The passages are narrow, the ladders steep and the hatches small, making transportation of the sick very difficult.

Very respectfully,

JOSEPHUS DANIELS,
Secretary of the Navy.

Under the title "Una nave-scula-sanatorio per fanciulli predisposti" Federico di Donato has urged this plan in Italy but up to the present the Italian Government has not assented.

The remark has been made that: "If the right sort of ship could be sent to the right place in the right kind of weather with the right sort of patients, a great deal of good might result."

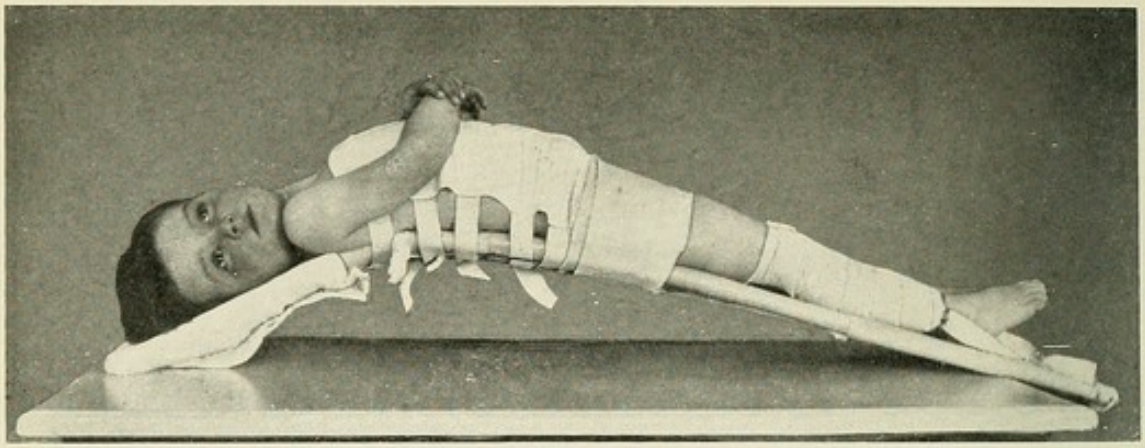
SEASIDE SANATORIA FOR CHILDREN

In the United States notable attempts have been made to utilize sea air in treating tubercular disease in children. Individual cases have been treated by sea air, but on a larger scale we should mention the experience of two institutions.

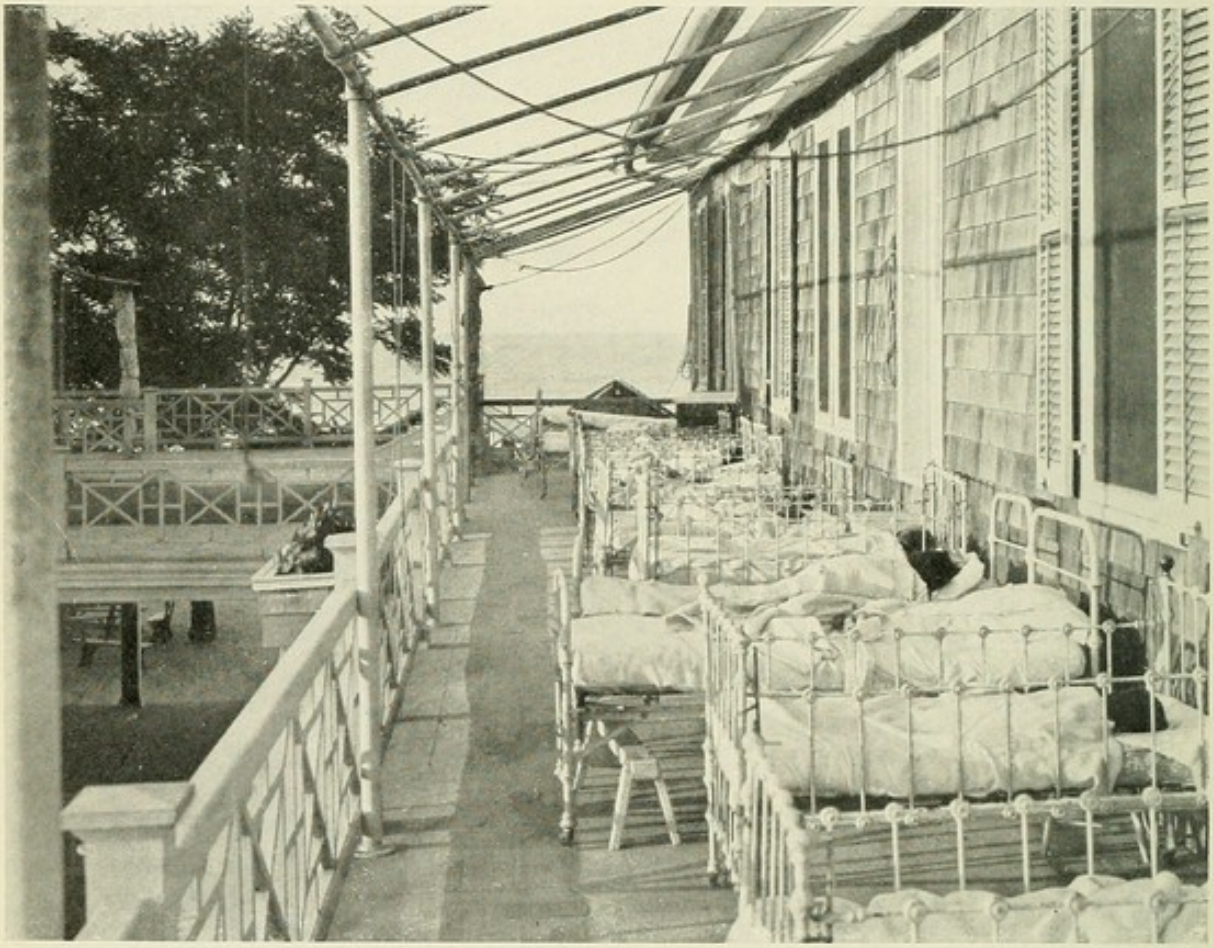
In 1872, Dr. William H. Bennett, of Philadelphia, established the Children's Seashore House at Atlantic City, New Jersey. This institution is open during the entire year, and in 1912 more than 3,500 mothers and children were cared for. Among the first patients admitted to the Institution at its inception were the hospital children suffering from tubercular diseases of the bones, glands, and joints. The wonderful improvement wrought in such cases by the sea air led to a steadily increasing demand for their admission, and now throughout the year seventy beds are set apart for their care and treatment.

The most notable and most recent attempt in the United States to treat cases of tuberculosis of the bones, joints and lymph nodes is at the Sea Breeze Hospital at Coney Island on the Atlantic

SEA BREEZE HOSPITAL, SEA GATE, CONEY ISLAND, NEW YORK. TUBERCULOUS CHILDREN ON THE BEACH



TREATMENT OF POTT'S DISEASE OF THE SPINE ON A BRADFORD FRAME. SEA BREEZE HOSPITAL, SEA GATE, NEW YORK. PATIENTS REMAIN FOR MONTHS, NIGHT AND DAY, ON THESE FRAMES, BUT ARE REMOVED TWICE DAILY FOR BATHING AND POWDERING
Courtesy of Dr. J W. Brannan



SEA BREEZE HOSPITAL, SEA GATE, CONEY ISLAND, NEW YORK. MORE CITY CHILDREN ARE STARVED FOR SLEEP THAN FOR FOOD. VIEW AT 6 A. M. IN SPRING. CHILDREN SLEEPING TEN HOURS ON PORCH ALL NIGHT. CANVAS OVERHEAD ROLLED BACK.

Ocean, ten miles from New York City. This was undertaken by the New York Association for Improving the Condition of the Poor. Ten tents were erected on the beach and were opened to children between the ages of two and fourteen on June 6, 1904. These tents had a capacity of fifty patients. In the autumn permanent buildings were occupied and have since been used. While the main reliance has been on fresh sea air and good food, the very best surgical aid has been employed, and for all major operations the children were temporarily removed to hospitals in New York City. This co-operative arrangement is a great advantage to the seashore institution, as the distance is not great and avoids the necessity of enlarging the surgical staff and at the same time provides the highest surgical skill. To avoid mistakes most of the cases admitted are seen by at least one other surgeon besides the attending surgeon. While pulmonary cases are refused the staff admits severe, desperate, and even hopeless cases.

In a recent report by two of the members of the staff[1] there are histories of forty-two cases and illustrations of the methods of treatment; but the noteworthy feature of the report is the prominence given to residence at the seashore as the chief means of cure. The conclusions from seventy-six histories which form a basis of the report are as follows:

(1) The seashore is the best place for treating children with tuberculous adenitis. The children make a better recovery here than elsewhere. Those with adenoids and enlarged tonsils should be submitted to an operation as a start of the cure. Sea air does not permit us to dispense with this.

(2) The seashore is probably the best place for children with tuberculous joints, provided they can have there the same skilled orthopedic care as elsewhere. Their disease runs a somewhat milder and probably a shorter course, and the functional results are better than those obtained elsewhere.

(3) Our results have been largely due to the careful attention (including feeding and nursing) which has been given the children.

(4) Our results justify pushing the work.

(5) A hospital such as this does better work than a public hospital under control of the municipality.

(6) Many cases of co-called bone tuberculosis are in reality syphilis.

We do not know whether there is anything "specific" about the seashore,

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[1] Leonard W. Ely and B. H. Whitbeck, Medical Record, March 7, 1908. See also Charlton Wallace, Medical Record, July 22, 1905; John Winters Brannan, Trans. American Climatological Association, 1905, p. 107; John Winters Brannan, Trans. National Association for the Study and Prevention of Tuberculosis, 1906. Roland Hammond: Heliotherapy as an Adjunct in the Treatment of Bone Disease, Amer. Journ. Orthopedic Surgery, May and October, 1913.

or whether children simply thrive better and so overcome more quickly their disease.[1]

As to treatment other than diet and fresh air, little need be said. We use plaster when we can in preference to braces. In Pott's disease we use first the Bradford frame, then plaster jackets; in hip joints, the short Lorenz spica. In knee-joint disease after the acute stages, we also use plaster-of-Paris. Patients with large cold abscesses are transferred to the Manhattan hospitals, where their abscesses are opened, wiped out, and sewn up again with proper aseptic precautions.

On January 21st of the present year, 1914, the author revisited Sea Breeze Hospital, Coney Island, New York, in order to see what is being accomplished. Six cases of hip disease were being treated by partial exposure of the body to the sun. The patients were in bed on the balcony with the usual extension apparatus in place. General exposure, beginning with the feet and gradually involving the entire body, is not adopted at Sea Breeze, as a rule, and only the area of abdomen, hip and thigh adjacent to the diseased joint was exposed to the air and sun. Continued cloudy and unfavorable weather had prevented much progress in the newer patients who were then undergoing treatment; others who had been cured of serious tuberculous disease by the open-air method had recently been discharged. The fresh-air system is, however, well carried out, but not upon the naked body as in Switzerland and France.

The temperature on the open balcony next to the wooden wall of the building was 62° F. at noon in the sun. It was the first bright day after weeks of storm and cloud. It is probable that the very encouraging experience of the last two years will lead to the adoption of Rollier's method in all its details as modified by the less favorable climatic conditions of this part of the Atlantic seaboard.[2]

Results at Sea Breeze Hospital in the treatment of tuberculosis of the bones, joints and glands have been so good that the city of New York has acquired a new location with 1,000 feet of beach front on what is known as Rockaway Point, ten miles beyond Coney Island. The plot runs back about 600 feet to Jamaica Bay and cost the city, after condemnation proceedings, $1,250,000. The plans include an arrangement of grounds and buildings which will involve a total

[1] Charlton Wallace, M. D.: Surgical Tuberculosis and Its Treatment (Journal of the Outdoor Life, March, 1913). This author, who is Orthopedic Surgeon to St. Charles' Hospital, Long Island, and the East Side Free School for Crippled Children, New York, says: The author is not in a position to produce scientific proof that sea air is better than country air, but he does believe such to be the case, although there are some individual patients who do better in the country than at the seashore.

[2] Heliotherapy is used at the Crawford Allen Hospital, Rhode Island.

outlay of $2,500,000, and there will be accommodation for 1,000 patients in the eight pavilions. Contracts for two of these pavilions have been let and will be paid for by a fund raised by the New York Association for Improving the Condition of the Poor. The new hospital will be turned over to the city of New York and will be conducted by Bellevue and Allied Hospitals. The plans include an immense playground running back to Jamaica Bay for the use of the public.

Credit is due to Dr. John Winters Brannan, of New York, president of Bellevue and Allied Hospitals, for much of the great work which has so far taken about nine years to accomplish and for which America will be justly proud.

Encouraged by the success at Sea Breeze, another hospital for surgical tuberculosis in children was started six years ago at Port Jefferson, on the north shore of Long Island, opposite the Sound. The situation is said to be ideal. It accommodates two hundred children and is a handsome fireproof structure. It is called St. Charles' Hospital; it is under the active care of the "Daughters of Wisdom," a Roman Catholic Society. The children, according to Dr. Wallace, receive every physical, mental, spiritual and industrial care necessary to produce good moral men and women. It is an active orthopedic hospital admitting any deserving case and keeping him there until the lesions are healed. Patients in advanced stages of bone tuberculosis are received as well as those with pulmonary complication. Under the good hygienic surroundings at St. Charles' Hospital, the children have shown great improvement in every way. Dr. Wallace adds: "The removal of the diseased bone with the knife is no longer attempted, because such a procedure not only takes away the root from which the bone grows, but also fails to eradicate the affected area. Reliance must therefore be placed on other than cutting methods for local treatment of the affected parts." Immobilization by plaster-of-Paris, properly applied and fresh air on the shore of Long Island Sound, conjoined with every other hygienic aid possible, constitute the line of treatment.

The New York Hospital for Ruptured and Crippled has lately removed to a new site on a hill near the East River, where the outdoor treatment for the tuberculous cripple is carried out as well as it can be in a large city.

In England it has long been customary to send scrofulous children and those with surgical tuberculosis to the eastern and southeast coast. At Margate the Royal Sea-Bathing Hospital, founded by

Lettsom and Latham in 1791, is the oldest institution of the kind in Great Britain, and retains its pre-eminence. There are similar institutions at Brighton, Bournemouth, Folkestone, and Ventnor, Isle of Wight (see plate 12).

The impression prevails at present in England that sea air is the best for these cases. The bracing air suits them perfectly and children with tuberculous bones, joints, or glands can stand a much colder and fresher air than children with pulmonary disease. Sea air improves the general health and keeps nutrition at the highest level. Italy and France, however, take the lead in seashore sanatoria exclusively devoted to tuberculous children. They have been in existence on the Italian shore at Viareggio since 1856, and on the French coast since 1860, and are conducted on a very extensive and systematic scale. The first sanatorium at Berck-sur-Mer was established in 1860 by the city of Paris, and is almost exclusively for children suffering from tuberculous disease of the joints, bones and glands, and has at present considerably over one thousand beds and accommodates children from the poorest quarters of Paris.[1]

Two private hospitals for similar cases are located at Berck-Plage. One was founded by Baron Rothschild and is maintained by his widow and contains 600 beds. Four-fifths of the cases are surgical; one-fifth, medical.[2] The other is in Cazin Perrochaud and accommodates 200. At Pol-sur-Mer there is a similar institution maintained by the city of Lille, which is designed to have 900 beds.[3] At Cannes there is an excellent private institution, the Villa Santa Maria, for the "cure helio-marine des tuberculoses chirurgicales" under the direction of D. A. Pascal.

Besides these institutions for surgical tuberculosis there are others which are intended mainly for pulmonary tuberculosis. These are located at Hendaye, Ormesson, Villiers-sur-Marne and Noisy le Grand. There are now fifteen sanatoria on the French coast open throughout the year and, in addition, a number open for only a part of the year, containing in all over four thousand beds. In 1904 there were twenty-three Italian hospitals distributed along the Mediterranean and Adriatic shores of Italy, with over ten thousand beds.

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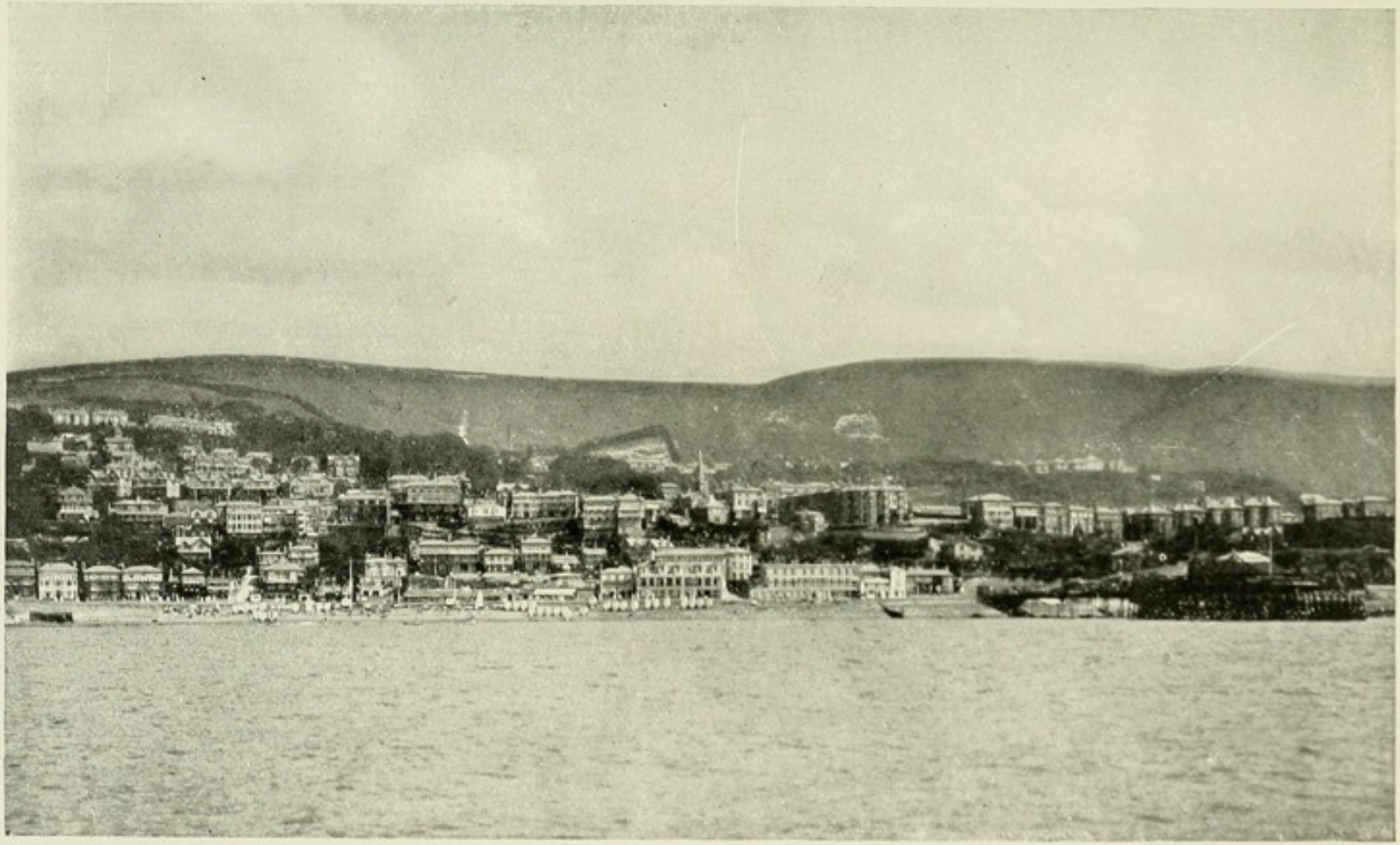
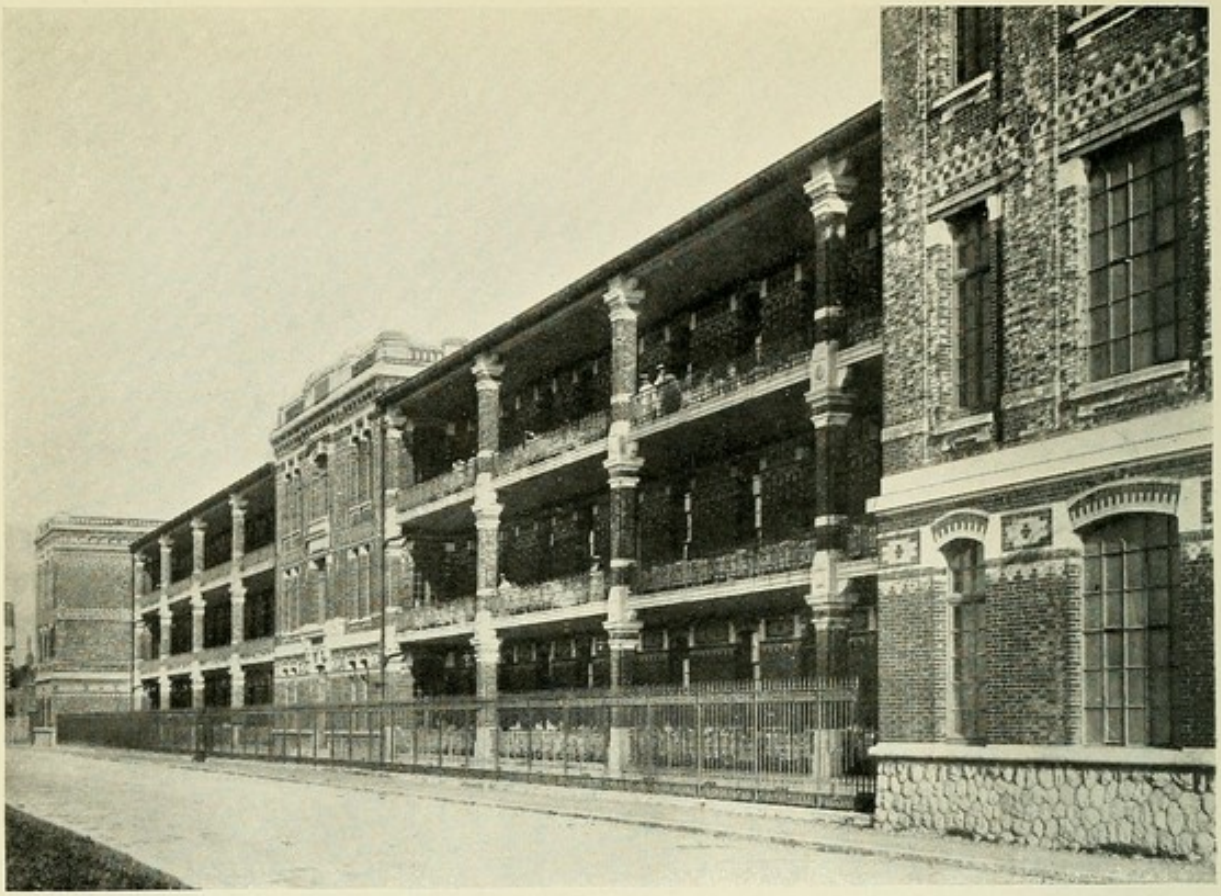
[1] See article by the author on "The Treatment of Surgical Tuberculosis," etc. Interstate Medical Journal, St. Louis, March, 1914.

[2] See article by Douglas C. McMurtrie, Boston Medical and Surgical Journal, Jan. 2, 1913.

[3] See article by John W. Brannan, *loc. cit.*



VENTNOR, ISLE OF WIGHT, ENGLAND. SITE OF THE ROYAL NATIONAL HOSPITAL FOR CONSUMPTION
Courtesy of Dr. T. A. Ross



WEST GALLERIES, MARITIME HOSPITAL FOR TUBERCULOSIS, BERCK-PLAGE, FRANCE. 300 BEDS

SOUTH GALLERIES, MARITIME HOSPITAL FOR TUBERCULOSIS, BERCK-PLAGE, FRANCE. 216 BEDS

These hospitals are said to be closed in winter. (Brannan.) Every other country in Europe, with the exception of Turkey and Greece, has one or more seashore sanatoria for tuberculous children, so that there are as many as seventy-five such hospitals on the shores of Europe. The Argentine Republic has two seashore sanatoria, one established twenty-three years ago with three hundred beds and a new one with five hundred beds.

The plan of treatment at all these institutions is very simple and ought to have been carried out on this side of the Atlantic long ago. The brilliant experience at Sea Breeze, Coney Island, is simply due to a repetition of the methods adopted for decades in France and England. The régime at all these sanatoria is about the same. The patients are kept out of doors all day on the beach or on verandas, which are covered but are open on the front and sides. Four meals a day with unlimited milk are provided. All through the winter the children occupy themselves on the grounds or on the beach; those confined to bed are on the open porches enjoying the sunshine and the sea air, the best tonics in the world, and developing a ruddy color and better general circulation than they have ever known. Their warm hands in the coldest winter weather is the wonder of all who visit them. At night the windows are wide open and the air has practically the same temperature as at any point on the coast, varying from 12° to 40° F. If the snow drifts in at night, as sometimes happens, nobody seems to be the worse. The windows are, however, closed for a half hour morning and evening while the children are being washed and dressed.

The surgeons at Berck-Plage, although engaged in active orthopedic work, are all firmly convinced that residence at the seashore, with the greater part of the twenty-four hours spent in the open air, does more for the children than could be accomplished even in the best appointed hospitals in the cities.[1] One of the surgeons at Margate, after fifteen years of constant work in the wards, states his opinion that the knife plays a very secondary part to climatic and general influences.

For an institution of this kind to attain the highest efficiency one thing seems plain; the patients must be admitted at a very early age, not from six years old and upwards, but as early as two years of age. In this respect the French and American sanatoria have the advantage of the English. The point has been made that at six years

[1] Each year during the early part of August vacation clinics are held, which are attended by large numbers of French and foreign physicians.

of age a child with tuberculous disease is often past cure. Much can be done with a tuberculous case if "caught young."

After serious operations, the surgeons at the seaside sanatoria note that progress is much more rapid when patients can live in the open air and the practical point has been discovered that subsequent dressings of a much more simple character are permissible under the open air régime. For instance, in Metropolitan hospitals the practice of packing and draining wounds has untold terrors for the unfortunate patients. Dr. Charlton Wallace found that at "Sea Breeze" tuberculous sinuses heal more rapidly and permanently when all packing and drainage are omitted and only a sterile absorbent dressing is applied. As the general instability of these patients is such as to cause them almost to collapse at the thought of having their wounds probed and packed, it led him to believe that they would gain strength and local resistance if they were not nervously upset at the time of each dressing. In the beginning, in order to ascertain whether there would be full drainage comparisons were made of the amount of discharge, with and without the full dressing, and as there was no diminution he concluded that packing or tubing was not essential to drainage. Not only was the danger of infection less, no infected wound being observed, but he found that no sinus healed which still contained pus. This certainly simplifies the treatment of surgical wounds and the credit is given to the favorable atmospheric conditions.

At Sea Breeze the children receive from one to two hours instruction daily, the teachers being furnished by the Brooklyn Board of Education. It has been noted that the educational training given at this Sea Breeze Hospital has a most happy effect on the morals of the patients and at this early age much more can be accomplished in combating vice and ignorance, which constitute the greatest obstacles in dealing with the tuberculosis problem.

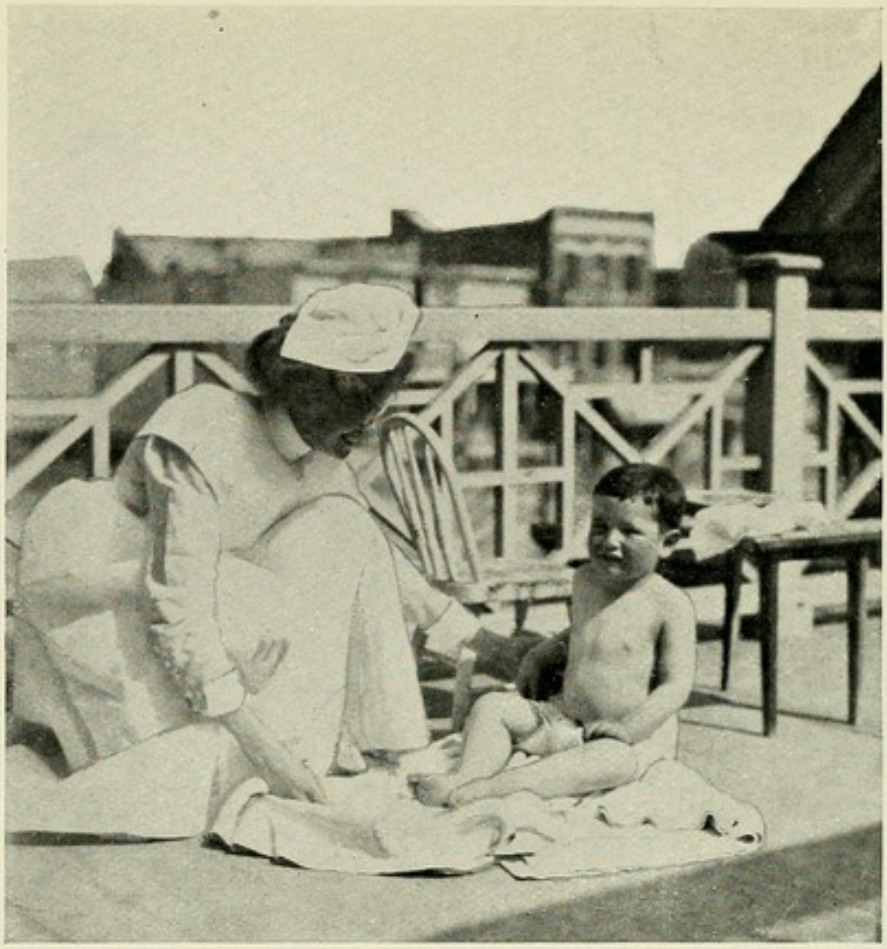
(For open air schools for tuberculous children, Waldschule, etc., see pp. 103-107).

In estimating the value of sea air in non-pulmonary tuberculosis in children, we naturally look to France for some data based on the enormous experience now extending over a period of nearly fifty years. During the last twenty years in France alone 60,000 children have been treated in these sanatoria and Dr. Brannan is authority for the following statement:

Cures, 59 per cent. Decidedly improved..25 per cent
Total of favorable results .....84 per cent
Cures in Pott's Disease .....32 per cent
Cures in glandular tuberculosis .....74 per cent

HELIOTHERAPY. VIEW OF THE SOUTH GALLERIES OF THE MARINE HOSPITAL, BERCK-PLAGE, FRANCE. THE CHILDREN ARE EXPOSED ALL DAY NAKED TO THE SUN

SEA BREEZE HOSPITAL, SEA GATE, NEW YORK. OPEN AIR SCHOOL
Courtesy of Dr. J. W. Brannan



HELIOTHERAPY. SEA BREEZE HOSPITAL, SEA GATE, NEW YORK, MARCH 18, 1913. CURED CASE OF TUBERCULOSIS OF THE KNEE. NO SINUS.

Courtesy of Dr. Brannan

HELIOTHERAPY AT SEA BREEZE HOSPITAL, SEA GATE, NEW YORK, OCTOBER, 1912. CHILDREN ON THE BEACH. CURED CASES OF TUBERCULOSIS OF THE WRIST AND ANKLE. THERE WERE OPEN SINUSES IN EACH CASE.

These results of the treatment of surgical tuberculosis at seashore sanatoria are much more favorable than in the case of pulmonary tuberculosis, in adults, in corresponding localities (see pp. 71-73).

Nevertheless, the Department of Public Charities of the City of New York has just built and equipped at an expense of $3,500,000, a new hospital for adults having pulmonary tuberculosis in the second or third stage. The site selected is on the highest point of Staten Island in New York Bay, 400 feet above tide and only five miles from

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[1] See R. Russell, M. D.: Glandular Tabes, or the Use of Sea Water in Diseases of the Glands. London, 1750.

Ebenezer Gilchrist, M. D.: The Use of Sea Voyages in Medicine. London, 1771.

Albert L. Gihon, M. D., U. S. N.: The Therapy of Ocean Climate (Trans. Amer. Climat. Ass., 1889, p. 50).

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John L. Adams: Report of 17 cases of Surgical Tuberculosis in Children (Boston Medical and Surgical Journal, 1906, Vol. 154, p. 17).

A. Crosbee Dixey, M. R. C. P.: Edinb. Lancet, Vol. 2, 1888, p. 264.

Boardman Reed: Effects of Sea Air Upon Diseases of the Respiratory Organs (Trans. Amer. Climat. Ass., Vol. 1, 1884, p. 51).

D'Espine, of Geneva. International Congress on Tuberculosis, Paris, October, 1905.

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Trans. Congrès de L'Association Internationale de Thalassotherapie, Cannes, April, 1914.

See also Willy Meyer: Open-Air and Hyperemic Treatment as Powerful Aids in the Management of Complicated Surgical Tuberculosis in Adults (Trans. Sixth International Congress on Tuberculosis, Washington, 1908, Vol. 2, twenty illustrations).

See also "Open Air Treatment of Tuberculosis," by the late Dr. DeForest Willard, *ibid.*, page 257. Also Trans. Amer. Orthopedic Ass., 1898. Shacks, bungalows, sleeping tents, sanatoria and day camps are discussed.

the ocean. This new addition to New York's equipment has one thousand beds and is called the "Sea View Hospital."

At the Second Annual Meeting of the National Association for the Study and Prevention of Tuberculosis held in Washington in 1906, the following resolution was offered by Dr. John W. Brannan and unanimously adopted:

> WHEREAS, Recent experience in Europe and in this country has shown that out-door life in pure air has the same curative effect in surgical tuberculosis as in tuberculosis of the lungs, therefore, be it
>
> *Resolved,* That in the opinion of members of this Association hospitals and sanatoria should be established outside of cities either in the country or on the seashore for the treatment from its incipiency, of tuberculosis of bones, joints, and glands in children.

SEACOAST AND FOGS

Marine climates naturally include the strictly ocean climate and that of the seacoast. In the former sea air comes from every point of the compass. It is always moist and it is the most equable air that blows; it is of infinite variety from the dead calm of the doldrums to the fierce gales of the North Atlantic.

The atmosphere of the seacoast is naturally modified at times by continental influences. Indeed the characteristic "sea breeze" which springs up in the morning and subsides toward sun-down is brought about by the ascent of heated air back of the coast. The hotter the interior and the more rapidly this air ascends the stronger is the sea breeze which rushes shoreward from the ocean and penetrates for fifty or a hundred miles the adjoining country.

But under other conditions land breezes occur and bring to the shore the Continental atmosphere of a totally different type. These atmospheric conflicts between sea and land involve most interesting meteorological problems; they tend to lessen the equability of the purely marine or oceanic climate. Freezing weather is the product of the Continent and the descent of cold waves from the interior; it brings to our northern seacoast frost and snow for a time, and never trespassing far upon the high seas. The seacoast has thus a mixture of two climates, but the sea air predominates and is never absent very long.

There are well-known places in America and in the British Islands where the sea breeze greatly predominates; Nova Scotia, Cape Cod, and Cape May in the United States; Land's End and the Cornish Coast in England are cases in point. In such exposed situations the air is generally poorly adapted to the tuberculous patient. The air

SEA BREEZE HOSPITAL, SEA GATE, NEW YORK. TREATMENT OF POTT'S DISEASE OF THE SPINE WITH PLASTER JACKETS AND HELIOTHERAPY

Courtesy of Dr. J. W. Brannan

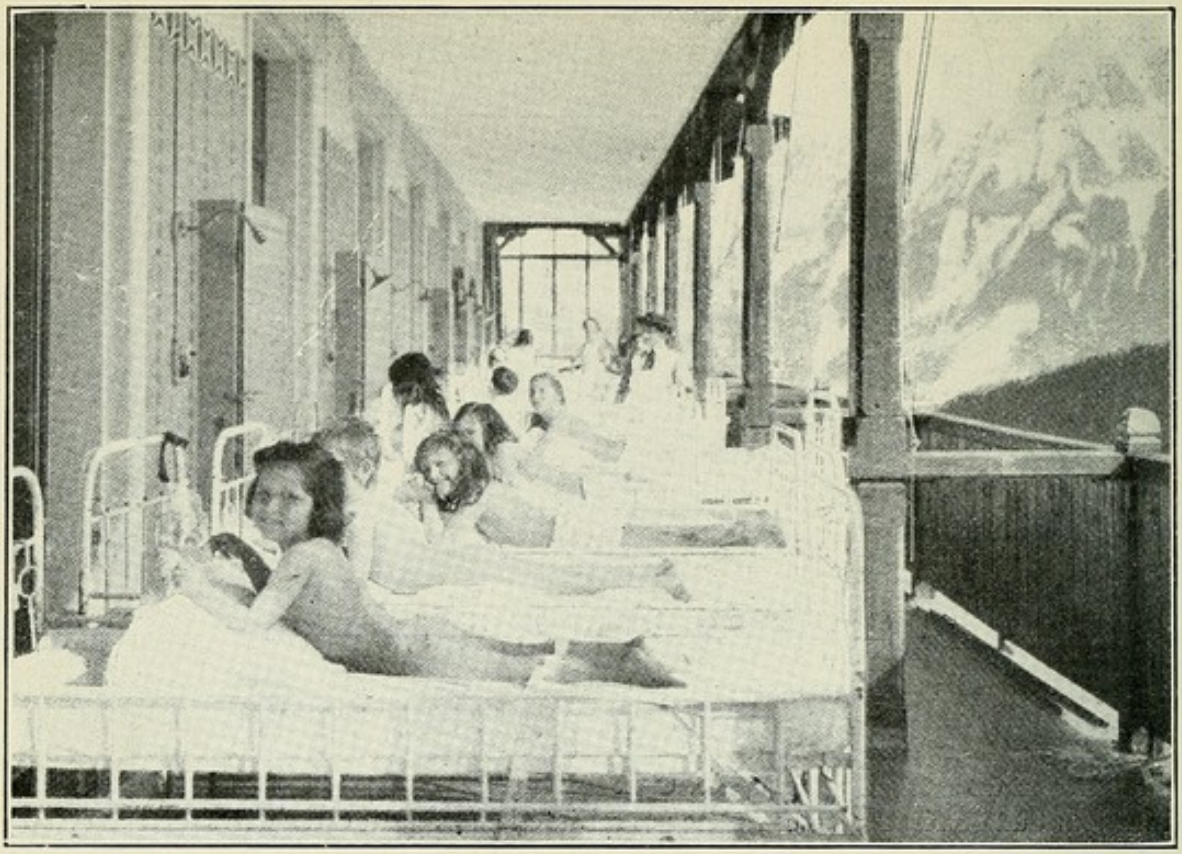


FIG. 1. HELIOTHERAPY FOR SURGICAL TUBERCULOSIS. DR. ROLLIER'S SANATORIUM, LEYSIN, SWITZERLAND. DORSAL EXPOSURE

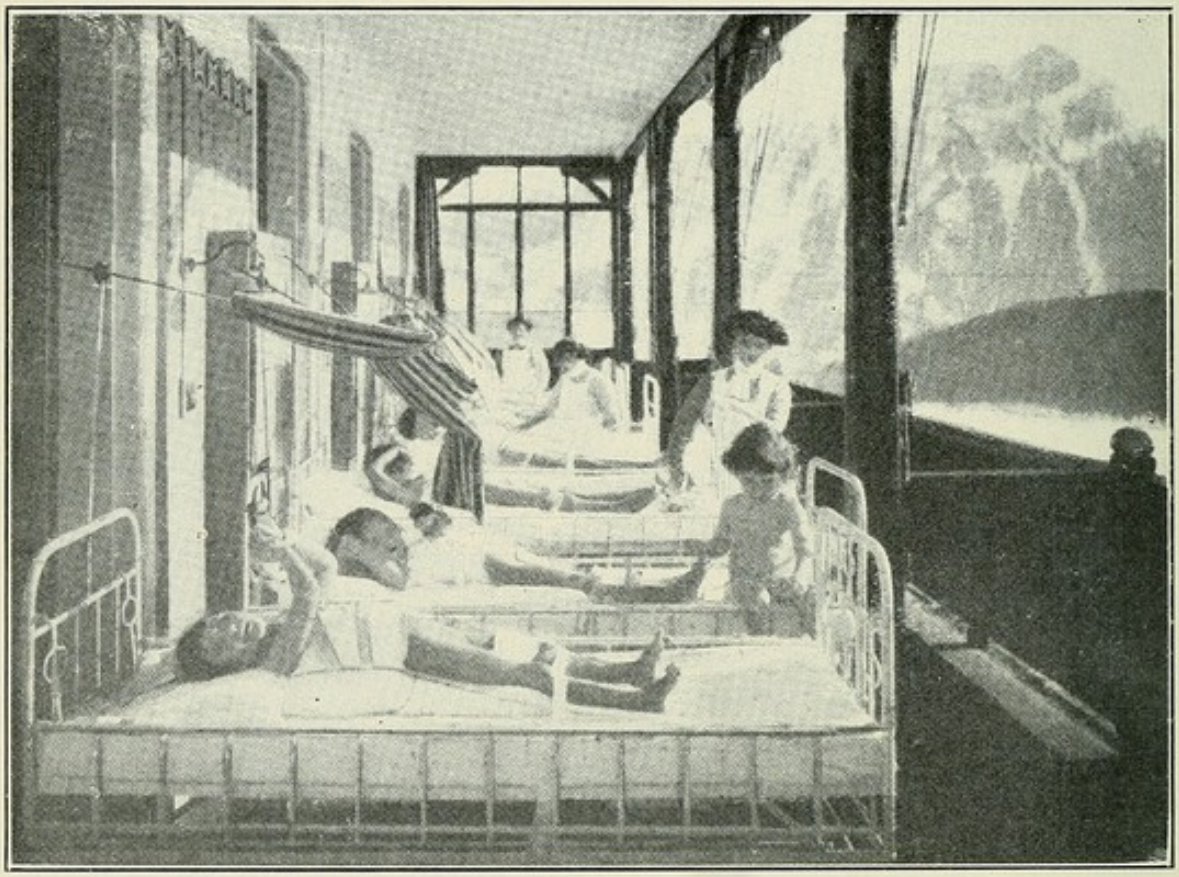


FIG. 2. HELIOTHERAPY FOR SURGICAL TUBERCULOSIS. DR. ROLLIER'S SANATORIUM. From the author's article in Interstate Medical Journal, March, 1914

is said to be " too strong " and certainly for an all-the-year-round residence the capes and headlands are too much at the mercy of high winds which render out-door life disagreeable. About Cape Cod, Nantucket, and Martha's Vineyard there is a peculiar liability to fog which is as unwelcome to the consumptive as it is to the mariner.

The author has had experience with the fogs in these waters and considers it one of the great drawbacks to an otherwise agreeable climate. The summer and early autumn fogs of the eastern Maine coast and of the Bay of Fundy and Nova Scotia are worse in their chilly and penetrating qualities. The towns of Massachusetts on or near the seacoast seem to have somewhat more tuberculosis than those of the interior.

DEATHS FROM PULMONARY TUBERCULOSIS IN MASSACHUSETTS PER 100,000 POPULATION

Five Maritime Towns	1905	1908-1912	*Five Inland Towns*	1905	1908-1912
Boston	224	155	Pittsfield	168	98
Salem	154	111	Springfield	125	89
New Bedford	164	124	Chicopee	125	109
Newburyport	181	131	Holyoke	154	131
Plymouth	162	90	North Adams	81	98
Average	177	122	Average	131	105

Mr. Hiram F. Mills, of the Massachusetts State Board of Health, has lately published a most painstaking analysis of the mortality from tuberculosis in all the towns and cities of that state.[1]

He shows that there are sixty cities and towns bordering on the sea having a total population of about one-third of the entire state, or 1,293,625, in which the average death-rate per 100,000 for the five years, 1908-1912, was 135. During this period the rate for the entire state was 131. Omitting Boston, which has peculiar conditions, from both calculations the rate was 111 for the remaining 59 maritime towns and cities against 124 for the remainder of the State. This throws the balance in favor of the seaboard. It should be noted that all the small and sparsely settled towns have low rates in almost regular gradation when compared with more and more populated districts.

Boston has had a noteworthy decrease in its tuberculosis death rate as shown by the following figures representing the rate for the last five years, namely, 271, 283, 254, 176, 182, or a decrease of one-third in five years. There are sixteen small towns having an aggre-

[1] Address to the State Inspectors of Massachusetts, November 3, 1913.

gate population of 5,540, in which there have been no deaths in all of the five years.

The map shows several inland towns with a large death rate owing to the presence of tuberculosis hospitals, asylums, and other institutions. These are marked with an H (not readily seen in the reduced map) and include Rutland, Sharon, Lakeville, Bridgewater, North Reading, Medfield, Westborough, Westfield, Taunton, Danvers, and Monson.

As Mr. Mills says:

> Forty years ago the death rate from consumption in Massachusetts was three times as great as it is now; thirteen years ago it had been reduced one-half in the previous forty years; to-day it has been reduced one-half in the past twenty years. There is no other State in the Union, in which records have been kept, where the reduction has been so much. From 1885 to 1909 it was more than twice as great as in England, Scotland, Ireland, The Netherlands, Belgium, Switzerland and Italy. The reduction is Prussia was 90 per cent of that in Massachusetts and that in Austria only 57 per cent. The registration system in Massachusetts is of the highest grade and in no other State or country of the world has such effective work been done and so much accomplished in reducing the death rate from tuberculosis as in that Commonwealth.

FOGS ON THE PACIFIC COAST

It is this element of fog which renders so much of the Pacific coast of the United States unsuitable for tuberculous patients. The morning fogs are conspicuous features of the climate and are acknowledged sources of danger to tuberculous cases. They penetrate as far as Los Angeles and Pasadena in the south, some eighteen miles from the coast; they are common in San Francisco, and are carried by ocean atmospheric currents through the Golden Gate, sweeping the bay and up the Sacramento and San Joaquin valleys.

There are portions of the California coast, as for example in the neighborhood of Santa Barbara, where the mountains are near the shore; and beyond the mountains are deserts and necessarily an exceedingly dry atmosphere. The night air from the mountains brings with it a dry Continental quality; the morning breezes bring a more humid air and possibly fog. In such localities fog is quickly scattered by the sun's heat and never penetrates very far inland. A suitable residence for tuberculous patients on the Pacific coast, as every native knows, is not found on the shore line but at some elevation above the sea fairly well up on the hillsides or in well-situated valleys, like the Montecito Valley, where the dryer air of the interior

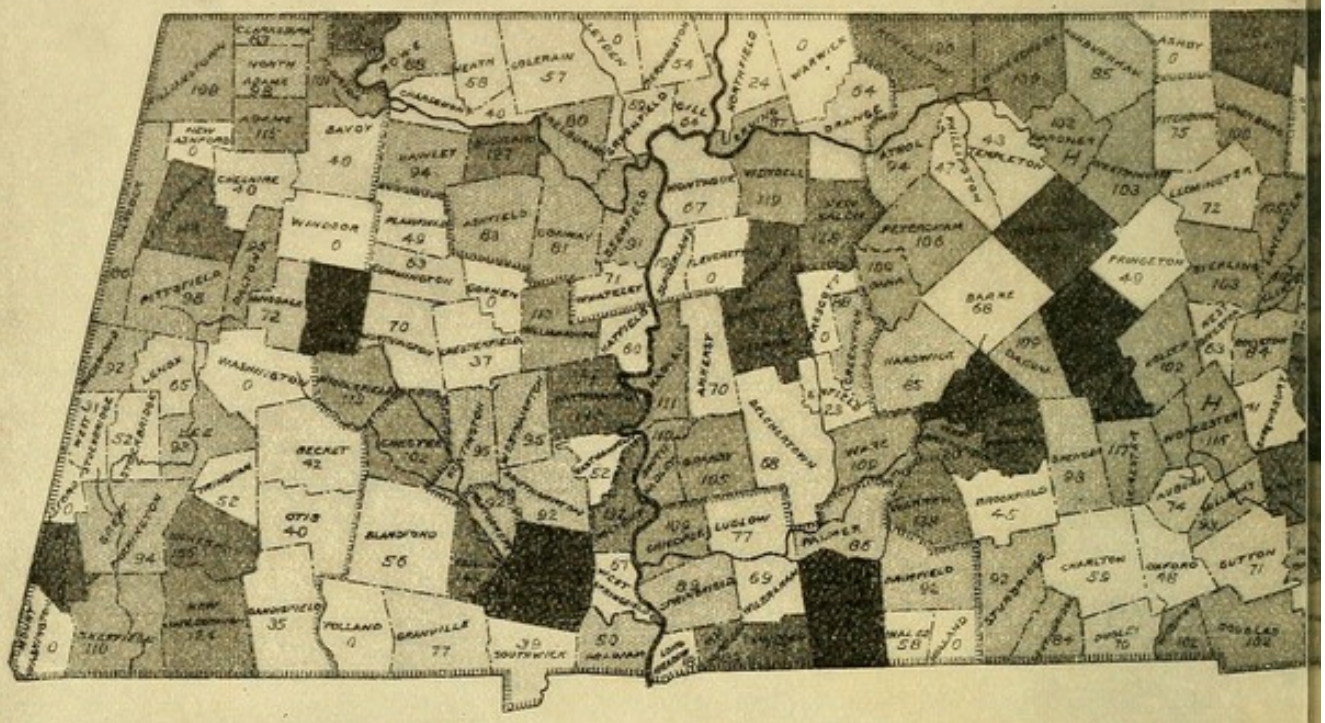
STATE BOARD OF HEALTH

MAP OF THE

STATE OF MASSACHUSETTS.

DEATHS FROM CONSUMPTION

SCALE OF MILES



STATE BOARD OF HEALTH

MAP OF THE

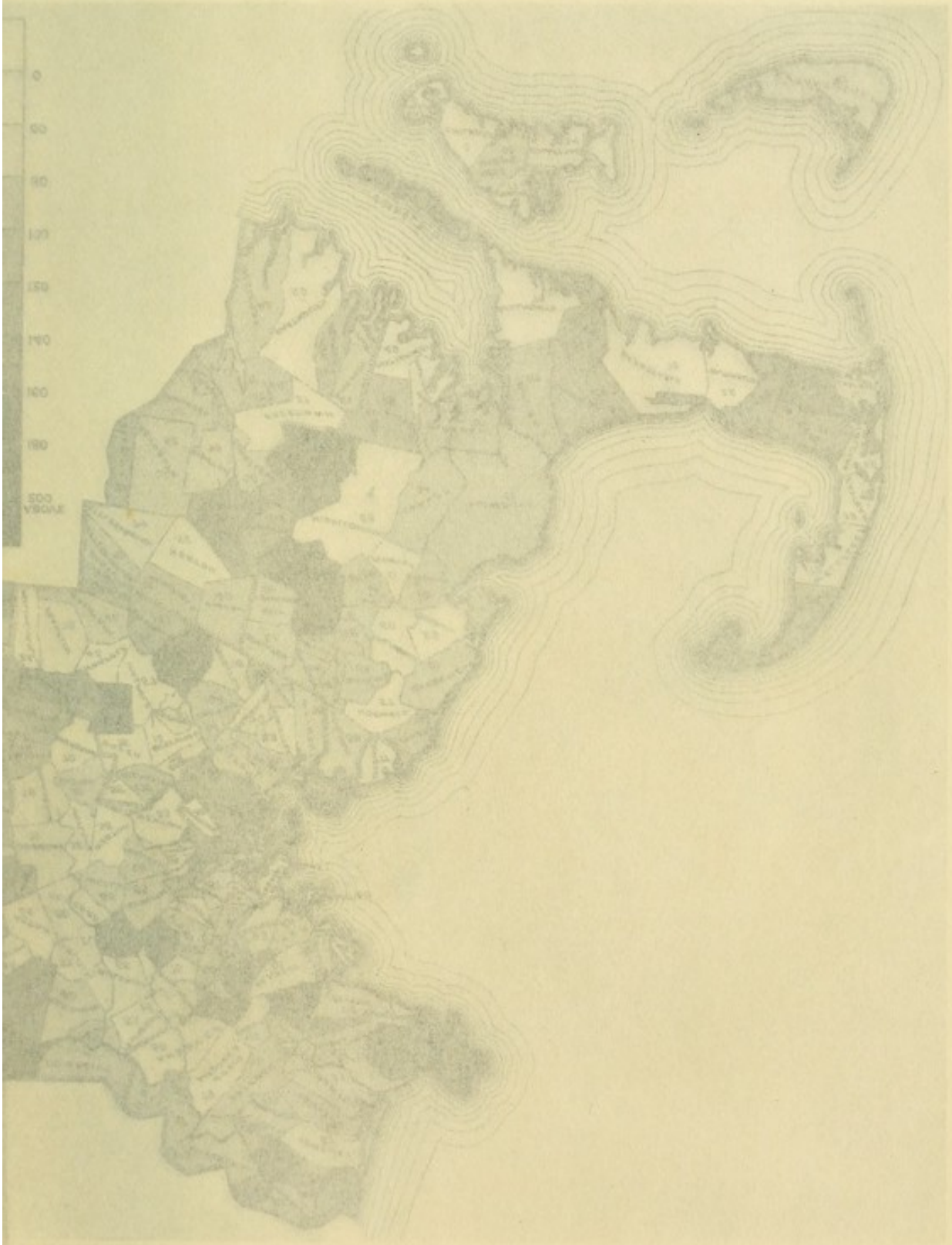
STATE OF MASSACHUSETTS.

DEATHS FROM CONSUMPTION

SCALE OF MILES

0 2 4 5 6 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50


ABOVE 200
180
160
140
120
100
80
60
0
NEWBURY
ANDOVER
NORWELL
MARSHFIELD
HANOVER
PEMBROKE
HANSON
MIDDLEBOROUGH
CARVER
PLYMOUTH
FREETOWN
DARTMOUTH
FALMOUTH
SANDWICH
BARNSTABLE
YARMOUTH
DENNIS
EDGARTOWN
NANTUCKET



checks the advent of fog and where the early morning hours are as bright and dry as the afternoons.[1]

RADIATION FOGS

Fogs are born of the sea and of the land. The sea fog is obviously purer and less injurious than the smoke-laden fog of cities. There are fogs and fogs; "dry" fogs and "wet" fogs; the fogs of the coast and the fogs of mountain valleys and river courses; but rarely of the plains. Radiation fogs are different from sea fogs; in dry weather, on a cold still night when the lowest stratum of air is rapidly cooled by contact with the cold radiating earth, the watery vapor is precipitated as minute globules. The colder the ground or the deeper and colder the water on which fog rests, the more persistent is the fog; but as the sun warms the watery particles and overcomes the heat lost by radiation, the fog lifts and floats upward. It is bound to lift as its specific gravity diminishes. Slopes of hills, especially their southern sides, some hundreds of feet above the lowland or seashore, are thus comparatively free from these fogs and are much drier and warmer than lower places in the neighborhood. Such locations are far preferable to those of lower altitude. (Russell.)

FOGS IN THE MOUNTAINS

And here we see how local geographic conditions modify the whole aspect of the question. On the North Atlantic Coast of the United States there are no mountain ranges; one cannot get away from the fogs if he would; while on the Pacific Coast, the mountains and their foot hills are comparatively near and one can be in full view of the seashore and yet be above the fog line.

At Santa Barbara, one of the favorite California resorts for tuberculous patients, fogs occur frequently from May until October, but are comparatively rare at other times. Dr. William H. Flint, who practiced there for thirteen years, says that the fogs creep in from the sea in the late afternoon, in the evening, or in the early morning, disappearing at an uncertain hour the following forenoon. Occasionally fogs will persist all day and for a number of days consecutively. In May and June, 1903, a foggy period continued for seventeen days.[2]

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[1] See A. G. McAdie: The Sun as a Fog Producer, Monthly Weather Review, Washington, 1913 (778-779).

[2] Trans. Amer. Climat. Ass., 1904, p. 20.

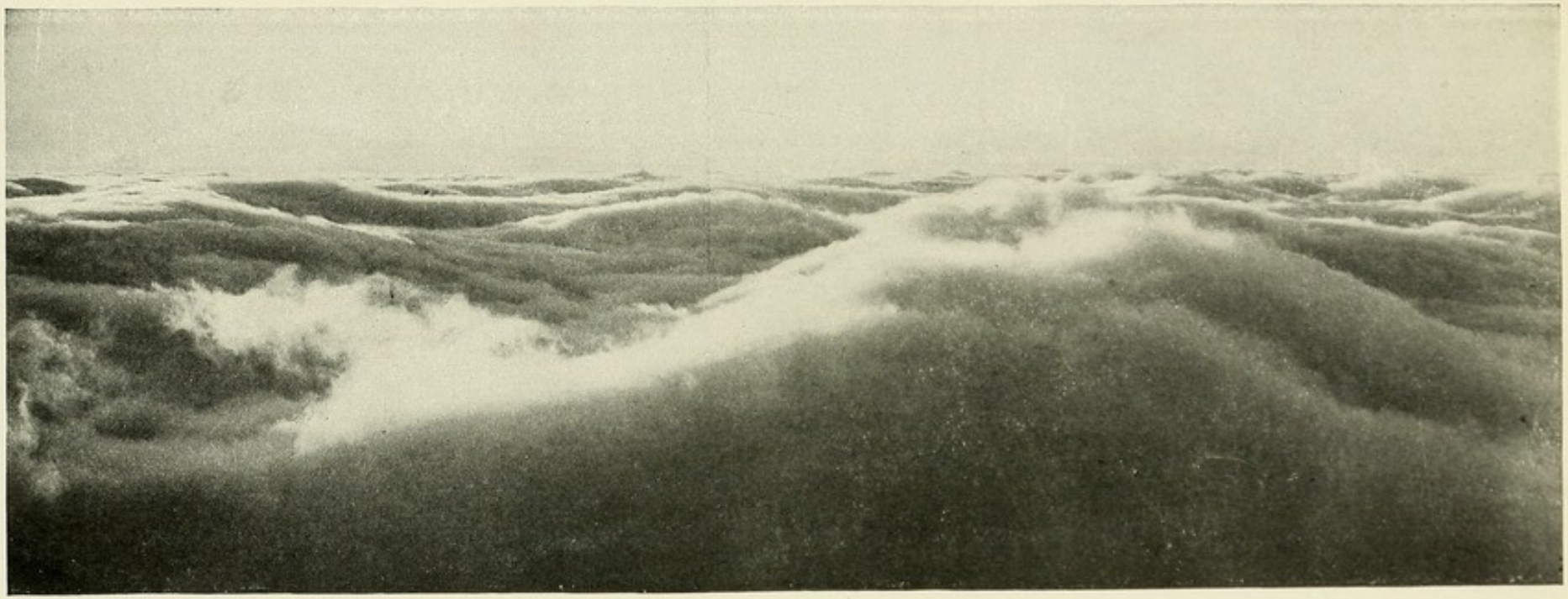
The late Dr. C. H. Alden, Asst. Surgeon General, U. S. A., who passed his later years, and died of tuberculosis, in Pasadena, California, says:

> The climate of Southern California is not a dry one, as some suppose. As this region lies along the coast, and its most frequented portions are nowhere very distant from the water, the climate cannot be dry. The humidity lessens as one goes inland, but is always considerable, except in the uninhabited desert. The fogs which, in the absence of much rain, are a large factor in sustaining vegetation, penetrate many miles from the sea and add to the humidity. *The fact that the humidity is not favorable for pulmonary tuberculosis which is at all advanced is evidently not appreciated as it should be.* [Italics, author's.]

Even as far as Redlands, over fifty miles from the coast, according to General Alden, who lived there for two winters, " fogs come up from the sea during the spring, but they are shorn of most of their moisture." Nevertheless, Redlands, from its comparative dryness, is a favorite place in winter for patients with pulmonary tuberculosis and they no doubt do better there than at Los Angeles, Pasadena, or at resorts directly on the coast. General Alden's conclusion is that while the mild temperatures and continuous sunshine of this region are favorable for the aged and the feeble from many causes, needing an out-door life, the warmth and moisture are unfavorable for cases of pulmonary tuberculosis that are at all advanced.

In June, 1902, the author traveled through the mountains and visited the principal resorts throughout California. The sea air with its frequent accompaniment of fog seemed to him too strong or fresh for tuberculous patients. North of Santa Barbara or Monterey the sea air is certainly cold and harsh during most of the year and, wherever it penetrates, tuberculous patients feel worse. This is particularly true of the neighborhood of San Francisco. From the summit of Mt. Tamalpais, elevation 2,375 feet, on almost any summer afternoon fog can be seen driving in from the Pacific and spreading over San Francisco Bay. As the sun descends the temperature of the air drops, so that saturation is reached. Fog results. Now on the southern California coast the cold, ocean atmospheric currents contain much less actual moisture than the warm, clear air on shore and the resultant mixture will now contain less water than the warm air did before and hence it is claimed with reason that notwithstanding the dripping roofs and wet pavements, there is less absolute moisture in the air than before the fog appeared.

We did not find the California fog either so cold or chilling as we have observed it on the extreme eastern coast of Maine; nor is it so



FOG WAVES. FROM THE SUMMIT OF MOUNT TAMALPAIS, OVERLOOKING SAN FRANCISCO BAY
Photograph by Prof. A. G. McAdie. Courtesy of the Chief of the United States Weather Bureau

"Banked in a serried drift beside the sea,
Rolling, wind harried in a snowy spray,
Majestic and mysterious, swirling free
The ghostly flood is massing cold and gray."

MORNING FOG OVER VALLEYS

Photograph by Prof. A. G. McAdie. Courtesy of the Chief of the United States Weather Bureau

depressing and relaxing as the heavy misty weather observed in central and western Virginia mountain valleys during the rains of early summer and autumn, certainly not so depressing as the relaxing moisture of the tropics. The California fogs have been likened to the Scotch mist. They never deter the fishermen from curing their fish on their racks along the seashore. Raisins and other fruit are dried in the open fields and residents claim that during the rainiest weather nothing molds or rots. (P. C. Remondino.)

Mr. Ford A. Carpenter, of the U. S. Weather Bureau, has published an interesting book, in which he gives a lucid description of the fogs of the Pacific Coast.[1] He shows that on that coast the maximum fog is reached in San Francisco, with moderately high averages north to the Canadian boundary and decreasing in frequency and duration with the latitude, San Diego having the least on the coast. He says that daylight fogs are practically unknown in San Diego. A "day with fog" is one on which there is one hour or more of fog dense enough to obscure objects one thousand feet distant. At San Diego the hours of greatest frequency were between eleven at night and six in the morning. Mr. Carpenter notes the beneficial effect of California fogs and says that it is impossible to measure accurately the amount of moisture conveyed by fog. There is no doubt that over a region covered by vegetation exposing a natural condensing surface, such as eucalyptus, palm, iceplant, etc., not less than a ton of water to the acre is thus distributed during the prevalence of every dense fog. It also checks evaporation.

"It is not fog in the generally accepted meaning, for this 'light veil' is neither cold nor excessively moisture-laden. Neither is it high, for its altitude is less than a thousand feet. To one who has spent a few weeks of spring, summer or fall in southern California, the picturesque description of the musical Spanish *el velo* is quickly recognized as both expressive and truthful." *"El velo de la luz"*: "the veil that hides the light." *"Velo qui cubre la luz del so"*: "The veil which shades (covers) the light of the Sun." *"El velo de la mañana"*: *"The veil of the morning."*

There is probably no place on the entire coast line of the United States that offers so many climatic advantages for tuberculous patient as San Diego and its attractive neighbor, Coronado.

It is a mistake to believe that because there is fog, the humidity is necessarily high during its presence. The United States Weather

[1] The climate and weather of San Diego, California. San Diego, 1913. See Review in Journ. Royal Meteorological Society, Jan., 1914.

Bureau has taken pains to determine the relative humidity during fogs observed during ten years at Chicago on Lake Michigan. Observations were made on 118 foggy days by Dr. Frankenfield, whose results are given as follows:

> Relative humidity 90 per cent (or more) in 75 per cent of days.
> Relative humidity 80 to 90 per cent in 13 per cent of days.
> Relative humidity below 80 per cent in 12 per cent of days.

The observer noted dense fog on one occasion when the relative humidity was as low as 52 per cent; on another, when it was 58 per cent.

The Pacific coast, as a whole, is much foggier than the Atlantic coast, because the winds on the Atlantic are mostly off-shore and consequently carry less moisture than the westerly on-shore winds of the Pacific.

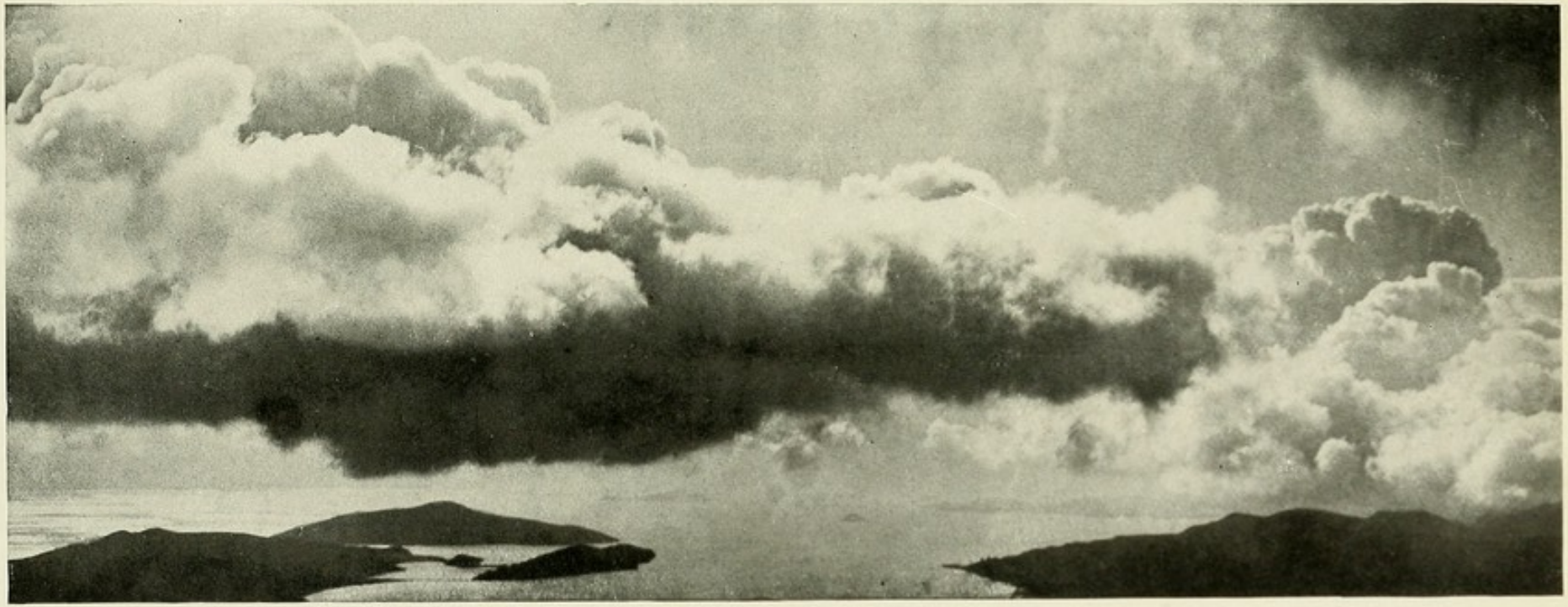
In the interior of the United States, especially the western half, the average number of foggy days per year is less than ten each year; in the Lake region the number rises to fifteen or twenty per annum. In isolated localities, local conditions increase this number greatly.

At Colorado Springs genuine fogs occur, sometimes very dense and lasting all day, but they are uncommon and scarcely worth mentioning were not their existence so often denied. (Ely.)

In the Adirondack Mountains fogs and mists are not uncommon along the rivers and on the lake shores in the early morning in the summer and autumn. They are examples of the radiation fogs already referred to and, like dew and frost, they are associated with clear weather. The presence of a light fog over an Adirondack lake in the early morning foretells a bright, sunny, warm day.

Fogs are not at all unusual in the Alleghany and Blue Ridge Mountains. They follow river courses and settle in low valleys. The humidity attendant on the melting of snow or during the rains of early summer or autumn is not so readily exchanged for dryer air in the long narrow valleys as at the seaboard. In many localities the high ridges on either side shut out the direct rays of sunlight for several hours; while at the seaboard there are no such natural barriers.

At some of the higher elevations in the Blue Ridge Mountains of Pennsylvania, fog is noted during the summer and autumn. One observer, himself a tuberculous patient, recorded at Mount Pocono, in Monroe County, Pa., elevation 2,000 feet, fifteen days with fog part of the day, usually early morning, and seven with fog all day,



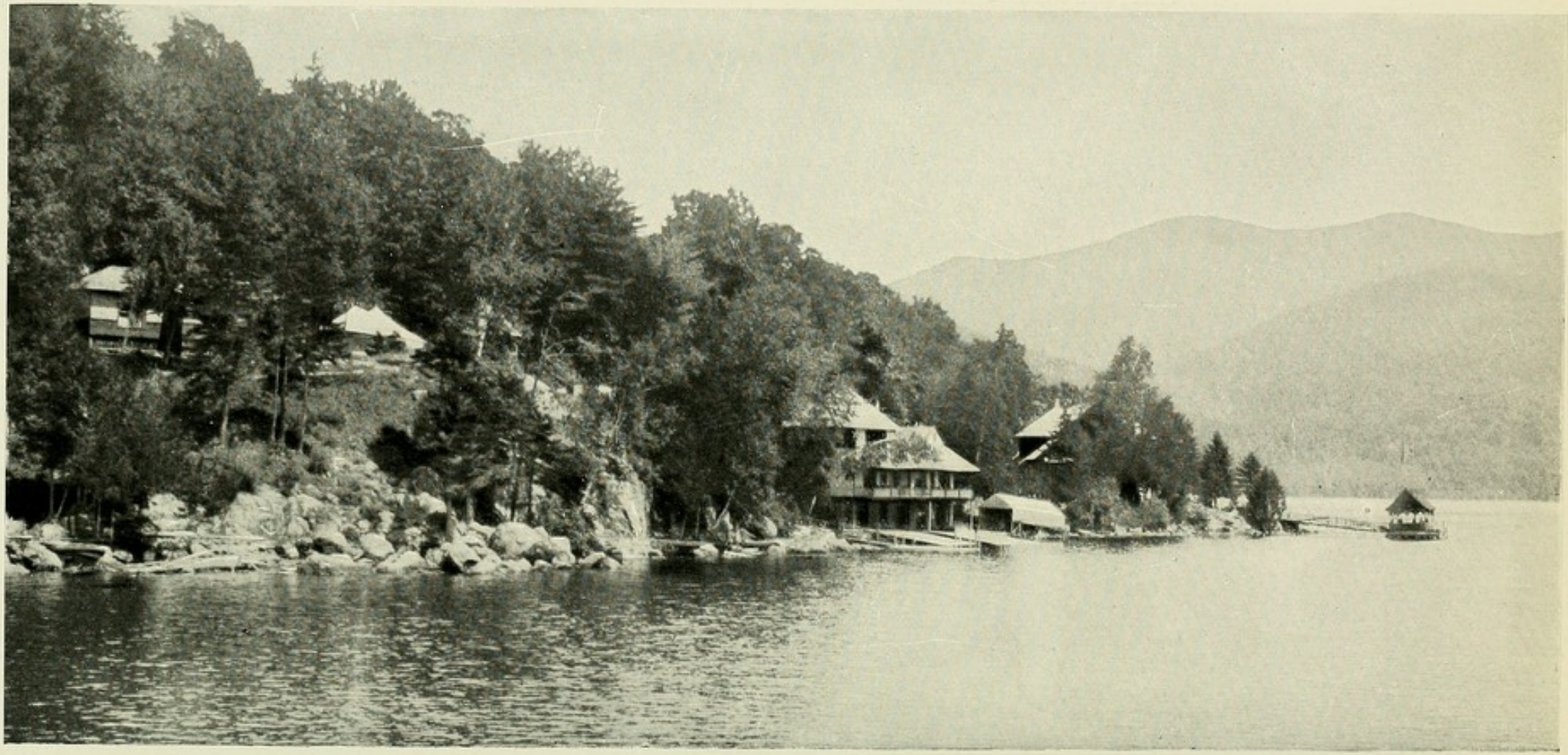
FOG LIFTING, SAN FRANCISCO BAY

Photograph by Prof. A. G. McAdie. Courtesy of the Chief of the United States Weather Bureau

SEA OF FOG FROM SUMMIT OF MOUNT WILSON, CALIFORNIA
From Photograph by Ferdinand Ellerman

FIG. 1. RUTLAND, MASSACHUSETTS, STATE HOSPITAL FOR CONSUMPTIVES

DAY CAMP FOR TUBERCULOUS PATIENTS, HOLYOKE, MASS.



UNDERCLIFF, A CAMP ON LAKE PLACID, ADIRONDACKS, NEW YORK
Courtesy of Dr. C. D. Alton

between June 1 and December 1. But this patient adds the significant remark: "However, it seems ridiculous for me to find fault with Mount Pocono when I did so well there. My cough and expectoration decreased considerably; I gained five pounds and grew somewhat stronger."[1]

At Rutland, Massachusetts, the site of the Massachusetts State Sanatorium, there were 24 days with fog for the year ending November 30, 1907. Nevertheless, out of 4,334 cases of pulmonary tuberculosis treated since its opening, 43.39 per cent of cases were arrested or apparently cured, and in addition, 47.38 per cent were improved.[2]

From what has been said, it is, therefore, not surprising that claims are made that there is a noticeable difference in the character of fogs on the New England Coast.[3] Dr. Bowditch has described the fogs on the Maine Coast as sometimes "dry fogs." "The light vapory mist which drives in frequently from the sea has no definite sense of moisture as it strikes the face, and in the midst of it the air frequently feels dry. In the vicinity of Mount Desert, the presence of the mountains has, doubtless, an effect upon the quality of the atmosphere, and would partly account for what is often spoken of—the effect of sea and mountain air combined. Its peculiar dryness, even though on the coast, has been often so marked that I have frequently thought that certain phthisical patients, who need a dry bracing atmosphere, might improve there, although I have never quite dared to recommend it for such cases."

SEA AIR FOR SURGICAL TUBERCULOSIS

Halsted, of Baltimore, however, has recorded a favorable result in a case of tuberculous glands of the neck, treated simply by an outdoor life on the Maine coast. The patient was a young lady of seventeen, whose cervical glands were actively inflamed and softened, the overlying skin having rapidly reddened and thinned during a treatment of six hours a day out of doors at a seashore further south. No operation was done, but she was sent to the Maine coast and lived *out-of-doors day and night* for four months. At the end of this period no one could tell, from the appearances, which side had been affected, and Halsted remarked that, to surgeons whose daily bread not long ago was tuberculous glands of the neck, such a

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[1] Journal of the Outdoor Life, February, 1908, p. 15.
[2] Eleventh Annual Report, 1907.
[3] Vincent Y. Bowditch, Trans. Amer. Climat. Ass., 1897, p. 25.

resolution foretells a revolution in treatment.[1] That revolution is, fortunately, to-day *un fait accompli.*

Some of the European sanatoria of the best grade are in situations not altogether free from fogs and mists. This is true of Falkenstein, elevation 1,378 feet (420 m.), whose atmosphere is a little misty and foggy.

AIR OF INLAND SEAS AND LAKES

The region of the Great Lakes lying between the United States and Canada has been studiously avoided in selecting a site for any of the large sanatoria for tuberculosis. It is a matter of common observation that nasal, pharyngeal, and bronchial catarrhs are exceedingly common in adjacent districts. The lake winds are damp and are partly frozen during several months in the year, giving to the surrounding country a harsh climate.

The lower lake region is also the favorite track of storms or cyclonic atmospheric movements which sweep the lakes and the St. Lawrence valley on their way to the seaboard. As these areas of low atmospheric pressure advance they are attended by increasing cloudiness in front and are usually followed by colder air from the Northwest, the fall in temperature being sufficient at times to constitute a cold wave.[2]

The winter storms on the Great Lakes are quite as violent as any on the seacoast, and on Lake Superior and Lake Huron floating ice may be seen in May and sometimes, in Lake Superior, as late as June. Lakes Michigan, Erie and Ontario are more southerly, but their shores are low and the skies are notably cloudy. The author has experience of the cold fogs of Lake Superior in July and August, and was impressed with their penetrating quality. A summer spent on both the northern and southern shores of Lake Superior was wonderfully exhilarating; the air has a purity and stimulus such as one might expect from millions of miles of forest roundabout. But not a single place on that vast shore can be recommended as a residence for a tuberculous patient. The vicissitudes of the weather are such that the approved methods of cure could not well be carried out.

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[1] Trans. Nat'l Ass. for the Study and Prevention of Tuberculosis, 1906.

[2] To constitute a cold wave, so called, there must be a fall of twenty degrees or more in twenty-four hours, free of diurnal range and extending over an area of at least 50,000 square miles, the temperature somewhere in the area going as low as 36° F.

WALLUM LAKE, RHODE ISLAND. PATIENTS OF THE STATE SANATORIUM FOR TUBERCULOSIS
Courtesy of Dr. Harry Lee Barnes

In the location of the state sanatorium for tuberculous patients in Minnesota, an interior and northerly location was wisely chosen, 150 miles south of Lake Superior, at Lake Pokegama, near the headwaters of the Mississippi.

The Wisconsin State Sanatorium has been located on Lake Nebagamon, thirty miles from Lake Superior.

Such small lakes as Lake Pokegama in Minnesota; the Muskoka Lakes in Ontario, where the Canadian National Sanitarium Association has established two sanatoria for consumptives; and the Saranac Lakes in the Adirondack Mountains, have no such power to modify the qualities of the atmosphere. Whatever influences are attributable to these smaller bodies of water are small, compared with that of the forest and mountains. Undoubtedly a small lake is a desirable feature in connection with a sanatorium, as it provides sources of amusement throughout the year and adds greatly to the beauty of the landscape. The writer spent six summers at Lake Placid in the Adirondack Mountains at an elevation of 1,860 feet. This is somewhat more protected than the Saranac Lakes, St. Regis Lake or Long Lake, and, in his opinion, is quite as well suited as a residence for tuberculous patients as any other locality in the Adirondacks. The State of New York has built its large State Sanatorium at Ray Brook only four miles distant from Lake Placid. The State of Rhode Island has chosen Wallum Lake for its new Sanatorium, views of which are here given.[1]

CHAPTER IV. INFLUENCE OF COMPRESSED AND RAREFIED AIR; HIGH AND LOW ATMOSPHERIC PRESSURE; ALTITUDE

No phase of the tuberculosis question has been so vigorously debated as the influence of altitude; no feature of the subject is so far from satisfactory solution. The battles between the Highlanders and the Lowlanders of Scotland seem to have been revived in the attempts to settle this question. Instead of the claymore and battle-axe, we have an array of statistics in serried columns marshalled by the leaders of the opposing forces. This history of the conflict would make as large a record as the Medical and Surgical History of the War of the Rebellion. And the end is not yet in sight.

After trying for years to cure consumption by means of an "equable climate" obtained at home by housing the patient behind double

[1] The large German Sanatorium Grabosee is located on the shores of Lake Grabow.

windows, or by sending him to the islands of the sea, such as Madeira and the West Indies, the medical profession began to be impressed with the good results reported from the Rocky Mountains and the plains of the Western states and territories.

In the rush to the California gold fields in 1849 and in the rapid emigration from Eastern states to Colorado, Utah, California, overland in the "prairie schooner" and on horseback during subsequent years, the Western country became known for wonderful health-giving qualities. It was not long before Colorado became widely heralded as a health resort for consumptives. English physicians sent their patients to Colorado instead of sending them to Australia, Algiers, or to the Riviera and the results obtained were remarkable. The late Dr. S. E. Solly, who practiced in Colorado for thirty-three years, was sent from London on account of the higher altitude and better air of Colorado, and was one of a large number of English residents who have made their home in that state on account of pulmonary tuberculosis.

In 1876, the late Dr. Charles Theodore Williams, of London, published his report to the International Medical Congress and in 1894 issued his work on Aero-Therapeutics, in which are detailed the histories of 202 consumptives who were sent to Colorado at an altitude of 5,000 or 6,000 feet. They represented a residence of 350 years at this elevation and the results were exceedingly satisfactory.

Jourdanet, a French physician practicing in Mexico, published two works, one in 1861 and one in 1875, which undertook to explain the influence of barometric pressure and, incidentally, why, on the plain of Anahuac, 6,000 feet in elevation, there is an entire absence of pulmonary phthisis.[1]

Jourdanet aided the great French physiologist, Paul Bert, in establishing costly apparatus for investigating the physiological action of compressed and rarefied air and Paul Bert's classic work is an accepted authority on this subject. Later studies by Mosso and Marcet[2] should be noted, but it is impossible here to give more than passing notice. They show that a diminution of the barometric pressure increases the respiration rate and the volume of air respired, but if allowances are made for the increase of volume of the air at the lower pressure, the actual volume respired is less. Conversely,

[1] D. Jourdanet: Influence de la Pression de l'Air, Paris, 1875. Herrera and Lope: La Vie Sur Hauts Plateaux, Hodgkins Prize Memoir, 1898.

[2] An American Text-Book of Physiology, Phila., 1901, Vol. 1, p. 434. Angello Mosso: Man in the High Alps (Der Mensch auf den Hochalpen, Leipsig, 1899), Translation by E. L. Kiesow, 1898.

an increase of pressure lowers the rate and the volume of air respired. The effects of the respiration of rarefied air and compressed air on the circulation and on the composition of the blood are very marked and are of a complex character owing to the additional influences of the abnormal pressure on the peripheral circulation. Not only is the circulation affected but, in the case of residence at high altitudes, the proportion of red blood corpuscles and of hemoglobin is notably increased. This increase in the red blood count at the higher altitudes, while not so great or so permanent as was at first supposed, is an established clinical fact and adds undoubted strength to the claim that altitude *per se* is a characteristic of the favorable climate for tuberculous patients.

DIMINISHED ATMOSPHERIC PRESSURE

The influence of diminished atmospheric pressure on the blood has been studied by Paul Bert in 1882,[1] Zuntz,[2] P. Regnard,[3] Viault,[4] Egger,[5] Woolff,[6] Koeppe,[7] Solly,[8] by W. A. Campbell and Gardiner and Hoagland,[9] by L. S. Peters[10] and by F. Laquer.[11] One of the

[1] Paul Bert, *loc. cit.*, studied the blood of animals at La Paz, in Mexico, at an altitude of 12,140 feet (3,700 meters) and found that they had an oxygen-carrying capacity far in excess of that exhibited by the animals on the lower plains.

[2] Zuntz: Experiments on the Pic du Midi, Elevation 9,000 feet. He emphasized the possibility of an altered distribution of corpuscles.

[3] Regnard, P.: La Cure d'Altitude, 2eime Ed. Paris, 1898.

[4] Viault: Experiments at Merococha, Peru, elevation 14,275 feet. 1890. He noted that his blood contained 7 to 8 million red corpuscles per cubic millimeter.

[5] Egger: The Blood Changes in High Mountains. Verhandlungen d. xii, Congr. Inner. Med., 1893.

[6] Woolff: Verhandlungen d. xii. Congr. Inner Med. 1893, pp. 262-276.

[7] Koeppe, xii. Congress für Inner. Med., 1893; Arch. Anat. Physiol., 1895, pp. 154-184.

[8] S. E. Solly: Blood Changes Induced by Altitude. Trans. American Climatological Association, 1899, p. 144; also 1900, p. 204.

S. E. Solly, Therapeutic Gazette, February, 1896.

[9] Campbell and Hoagland: Trans. American Climatological Association, 1901, p. 107.

[10] For the effect of altitude, 6,000 feet, on blood pressure in tuberculous patients, see article by L. S. Peters, Silver City, New Mexico, in Archives of Internal Medicine, August, 1908 and October, 1913. The latter report covers 600 cases and shows that altitude tends to raise blood pressure rather than lower it both in consumptives and in normal persons living at high altitudes.

[11] F. Laquer: Höhenclima und Blutneubildung, Deutsches Archiv für klin. Med. Leipzig, 1913, cx, Nos. 3 and 4, p. 189.

most thorough original studies is by Drs. Ossian, Schaumann and Emil Rosenquist, of Helsingfors, Finland.[1] Turban, also, has made a study of this subject.[2]

Much of the earlier work has been proved incorrect as instrumental and laboratory technic has been improved. Hematologic work has made rapid strides and several important correcting factors have been introduced. Attention has been called to the more rapid evaporation of blood samples at high altitudes where the climate is always dry and errors from this source are considerable.

Not only that, but the human organism itself loses water more readily than at lower levels and so do animals used for experimental purposes. How much value should be given to these corrections we do not know, but there is evidently a revision downwards noticeable in nearly all the later studies of the blood count at high altitudes. Prof. Bürker, of Tübingen, and his colleagues show at best only a comparatively small increase amounting to only four to eleven and a half per cent at an altitude of six thousand feet.[3]

These observers made comparative observations at Tübingen (altitude 1,030 feet or 314 meters), and at the Sanatorium Schatzalp (altitude 6,150 feet or 1,874 meters, about 300 meters above Davos).

Bürker's findings, which appear to result from an exceptionally careful personal investigation with every precaution to avoid experimental error, show that altitude does exert an unquestionable influence on the blood in the direction of an increase in both the number of erythrocytes and the content of hemoglobin. The increase is an absolute one, not merely relative. The red cells increased from 4 to 11.5 per cent, the hemoglobin from 7 to 10 per cent. These figures, it will be noted, are smaller than those usually given for the effect of moderate altitudes, yet they represent substantial and undeniable gains quite in harmony with other previous observations.

The responses of the different persons in Bürker's Alpine expedition varied in degree; but the qualitative examination of the blood established the fact that no hemoglobin derivative other than oxyhemoglobin was concerned in

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[1] Ossian, Schaumann and Rosenquist: Ueber die Natur d. Blutveranderungen in Hohen Klima, Zeitschr. f. klin. Med., 1898, Band xxxv, Heft 1-4, pp. 126-170 and 315-349.

[2] Turban, Münch. Med. Wochenschr., 1899, p. 792.

[3] See Editorial Altitude and the Blood Corpuscles, Journ. Amer. Med. Ass., February 3, 1912, p. 344; September 21, 1912 and November 1, 1913.

Bürker, K.; Jooss, E.; Moll, E., and Neumann, E.: Die physiologischen Wirkungen des Höhenklimas: II. Die Wirkung auf das Blut, geprüft durch tägliche Erythrozytenzählungen und tägliche qualitative und quantitative Hämoglobinbestimmlungen im Blute von vier Versuchspersonen während eines Monats, Ztschr. f. Biol., 1913, Vol. 61, 379.

the increment at altitudes. In agreement with most observers the adjustment of the blood to the new atmospheric conditions in ascending to higher levels occurs promptly; there is a rapid increase in the factors involved at the start followed by a more gradual continuation of the effect; but on returning toward the sea-level the blood does not resume its "low altitude" composition so promptly. There may be a prolonged delay in the adjustment and return to normal figures.[1]

Cohnheim[2] regards evaporation as the cause of the concentration of blood under these conditions and that this is not due to a lack of oxygen. These studies in hematology have an important bearing on the course of tuberculosis at high altitudes, and constitute a very live question at the present day.

Professor Cohnheim and Dr. Weber[3] have recently reported the results of examination of the blood of twenty-three persons who have been engaged for long periods in the operations of the railway ascending the Jungfrau peak in the Alps. Most of them spent considerable portions of their time at altitudes from 2,300 meters (7,546 feet, Eigergletscher Station) upward to 3,450 meters (11,319 feet, Jungfraujoch Station). The importance of these observations lies in the fact that they furnish data regarding persons who have had prolonged experience in the higher altitudes so that the incidents of temporary residence and change of scene may be regarded as equalized or eliminated. They supplement the earlier records from the South American plateaus by results obtained with approved and up-to-date procedures. The new statistics agree in exhibiting values both for red blood-corpuscles and hemoglobin distinctly higher than the "normals" of sea level. Cohnheim maintains that the high figures thus obtained on a large scale from subjects accustomed to live at high atmospheric levels leave no alternative except to assume a new formation of corpuscles under such conditions. Where contrary conclusions have been reached—and there are many such—it is not unlikely that the period of residence was too brief to permit the stimulating effects of altitude to manifest themselves in any conspicuous way.

The renewed assumption of an increased functioning of the hemopoietic organs at high altitudes has further been supported by observations conducted on Monte Rosa in the Alps relating to the regeneration of blood after severe anemias. In the international laboratory built on the Col d'Olen at an altitude of 2,900 meters (9,515 feet) and dedicated to the memory of Angelo Mosso, Laquer[3] has found that dogs deprived by hemorrhage of half their blood-supply regenerate it in about sixteen days. Under precisely comparable experimental conditions twenty-seven days are required at lower levels for the restoration of the same blood loss. Laquer believes that the lower partial pressure of the oxygen is the effective stimulating factor in this more pro-

[1] Editorial in Journ. Amer. Med. Ass., Nov. 1, 1913, *q. v.*

[2] For a recent review of this subject see Cohnheim, O.: Physiologie des Alpinismus, II. Ergebn. d. Physiol., 1912, xii, 628; also Anglo-American Expedition to Pike's Peak, Journal Amer. Med. Ass., Aug. 10, 1912, p. 449.

[3] Cohnheim, O., and Weber: Die Blutbildung im Hochgebirge, Deutsch. Arch. f. klin. Med., 1913, cx, 225.

nounced regeneration so strikingly shown at great heights. How long this latest explanation will withstand the attacks of the increasing number of Alpine physiologists remains to be seen.[1]

The latest observations show that arterial blood contains considerably more oxygen at high altitudes than at sea level. The pulmonary alveoli have a special power of extracting or secreting oxygen and this power is increased in high altitudes, this increase not disappearing until a considerable time after descent to sea level.

W. R. Huggard, of London, an unbiassed and judicial observer, says: "The diminished frequency of tuberculosis with altitude may, I think, be taken as established."[2] Hirsch[3] held the same opinion and based his statement on statistics from various places.

Thirteen years ago, Dr. Solly endeavored to show this statistically and arranged three tables which we append.

TABLE I

COMPARATIVE RESULTS IN SANATORIA IN HIGH AND LOW CLIMATES

COMBINED FIRST AND SECOND-STAGE CASES ONLY

(Taken from Dr. Walters, pp. 52 and 53)

1876–1886	Altitude	Number of Cases	Number Benefited	Per Cent	
LOWLAND CLIMATES					
Goerbersdorf (Manasse)	1,840 ft.	3,615	1,294	36	
Falkenstein (Dettweiler)	1,375 ft.	1,022	746	73	71
Reiboldsgrün (Driver)	2,300 ft.	2,000	1,400	70	
Total		6,637	3,440	Average, 51	
HIGHLAND CLIMATES					
Leysin (Bernier)	4,150 ft.	37	34	92	
Davos (Turban)	5,115 ft.	302	269	89	
Arosa (Jacobi)	6,000 ft.	259	212	82	
Total		598	515	Average, 86	

The total average of benefited in low climates was 71 per cent[1]
" " " " " high " " 86 "

[1] Without Goerbersdorf.

The Goerbersdorf reports up to 1884 are so much lower in the percent of benefited to the others—owing, perhaps, to some different method of estimating results, or, perhaps, to their being taken so many years ago, when the material was worse and the treatment perhaps not as efficient—that probably it would bring out the truth better to omit them.

[1] Editorial in Journ. Amer. Med. Ass., July 26, 1913.

[2] W. R. Huggard: A Handbook of Climatic Treatment, London, 1906, p. 124.

[3] Hirsch: Geographical and Historical Pathology, New Sydenham Society Translation, 1886, Vol. 3, p. 440.

TABLE II

COMPARATIVE RESULTS IN OPEN RESORTS IN LOW AND HIGH CLIMATES

ALL STAGES

(Taken from Handbook of Climatology, Solly, pp. 132 and 133)

	Number of Cases	Number Benefited	Per Cent
LOWLAND CLIMATES			
Desert Climates	154	100	65
Island Climates	568	295	52
Coast Climates	2,328	1,369	59
Inland Climates	136	77	57
Total	3,186	1,841	Average, 58
HIGHLAND CLIMATES			
Alps (Davos)	2,027	1,551	77
Colorado	571	420	73
Total	2,598	1,971	Average, 76

The total average of benefited in lowland climates was 57 per cent
" " " " " " highland " " 76 per cent

The first table, Table I, deals with the comparative results in sanatoria in high and low climates, first and second stage cases combined being alone taken, and the different variety of forms of improvement being grouped under the head of benefited. Of the lowland sanatoria the lowest elevation above sea-level was 1,840 feet, and the highest 3,300 feet. Of the highland climates the lowest elevation was 4,150 feet, and the highest, 6,000 feet. The total average percentage of benefited in low climates was 71, and in high climates 86.

Table II gives comparative results in open resorts in low and high climates. The total average of benefited in lowland climates was 57 per cent, in highland climates 76 per cent.

TABLE III

COMPARATIVE RESULTS IN HIGH AND LOW CLIMATES IN OPEN AND CLOSED RESORTS

Sanatoriums	Per Cent Benefited	Open Resorts
LOWLAND CLIMATES		
Hygeia (A. Klebs)	69	
Goerbersdorf (Brehmer)	76	
Adirondacks (Trudeau)	77	
Average	74	Average percent of benefited, 58
HIGHLAND CLIMATES		
Davos (Turban)		
Arosa (Jacobi)		
Average	84	Average percent of benefited, 76

Table III shows the comparative results in high and low climates in open and closed resorts. The cases, however, could not be obtained in first and second stage cases alone, but only of all stages combined. In lowland climates the closed sanatoria show 74 per cent benefited, and the open resorts 58 per cent benefited. In highland climates the closed sanatoria show 84 per cent benefited and the open resorts 76 per cent, exhibiting the relative superiority of sanatorium over open resort treatment in the two classes of climates, respectively. Doubtless the sanatorium cases were on the whole in better condition upon first coming under treatment than those in the open resorts and, therefore, the superiority of sanatorium treatment over open methods is probably not as great as it appears here; but, nevertheless, even if the material were exactly the same, the sanatoria would show a greater percentage of benefited over the open resorts.

Table III also proves that climate exercises a beneficial influence over patients in closed sanatoriums as well as in open resorts. In all stages combined the percentage of benefited in sanatoria in low climates was 74 per cent, while in high climates it was 84 per cent.

In the first and second stage cases combined (see in Table I), the difference in favor of mountain sanatoria is still greater—lowland sanatoria 71 per cent; highland sanatoria 86 per cent.[1]

The following is the classification of the National Association for the Study and Prevention of Tuberculosis adopted in May, 1913. The data given in the table on page 69 are given in terms generally used up to that time.

CLASSIFICATION OF SUBSEQUENT OBSERVATIONS

Apparently Cured: All constitutional symptoms and expectoration with bacilli absent for a period of two years under ordinary conditions of life.

Arrested: All constitutional symptoms and expectoration with bacilli absent for a period of six months; the physical signs to be those of a healed lesion.

Apparently Arrested: All constitutional symptoms and expectoration with bacilli absent for a period of three months; the physical signs to be those of a healed lesion.

Quiescent: Absence of all constitutional symptoms; expectoration and bacilli may or may not be present; physical signs stationary or retrogressive; the foregoing conditions to have existed for at least two months.

Improved: Constitutional symptoms lessened or entirely absent; physical signs improved or unchanged; cough and expectoration with bacilli usually present.

Unimproved: All essential symptoms and signs unabated or increased.

Died.

[1] Dr. S. E. Solly, in the Philadelphia Medical Journal, December 1, 1900.

It is practically impossible to draw accurate conclusions from data furnished by different institutions, under such wide variations as to the character of the patients and varying standards as to what constitutes an apparent cure or arrested disease. A glance at the chart or table shows that good results are obtained at all eleva-

Sanatoria	Elevation	Apparently Cured	Disease Arrested	Improved	Unimproved	Died	Year	Stage
	feet	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*		
Sharon, Mass.	250	56	18	33	9	.....	1891–1911	All
Barlow, Los Angeles, Cal.	300	3	4	40	35	13	1907	All
		3.5	6	39.5	27.5	22	1903–7	Chiefly advanced
		16	16	42.8	9	1.7	1912	
		31.14	14.7	32.8	9.8	6.5	1913	
Wallum Lake, R. I. (State)	650	8.5	32.9	33.6	23.7	1	Previous to 1912	All
		6.7	27.4	38.3	24.9	2.5	1912	
Muskoka, Canada	700	5.54	20.8	45.41	24.56	3.67	1902–12	All
Pottenger, Monrovia, Cal. (Private)	1000	68	21	11	.....	.....	1909	Incipient
		25	50	17	4	4	to	Second
		8	33	36	8	15	1912	Third
Otisville, N. Y. (State)	1200	12	47.3	27.7	10.5	1.3	1913	All
Rutland, Mass. (State)	1165	26.1	35.6	29.5	9	.....	1906	Early
New Jersey State (Glen Gardner)	900	12	29	42	16	1	1912	All
White Haven, Pa. (Free Hospital)	1250	.....	17.1	59.9	13.7	3.3	1901–13	All
Adirondack Cott. Sanitarium, Saranac Lake, N. Y.	1750	48.3	36.3	.....	15.4	.....	1885–1911	Incipient
		8.8	48.2	.....	43	4.2	.....	Moderately and far advanced*
Ray Brook, Adirondacks, N. Y. (State)	1635	34.4	31.6	17.3	14	.9	1912	All
New Mexico Cottage Sanitarium, Silver City (600 cases, Private)	6000	83	17	.....	.....	.....	1904–13	Incipient 19%
		50	33	8	6	2	.....	Moderately advanced, 19%
		13	30	25	26	4	.....	Far advanced 62%
U. S. Public Health Service Sanatorium, Fort Stanton, N. M. (For Sailors)	6231	11.7	15	29.1	9.5	34.5	1899–1912	All
U. S. Army Hospital, Fort Bayard, N. M.	6400	2.02	2.87	69.25	19.59	6.25	1911	All
		4.78	11.40	52.38	23.80	7.64	1912	All

tions. The best results are claimed in incipient cases by the Pottenger (Private) Sanatorium, Monrovia, California, 1,000 feet, and New Mexico Cottage Sanatorium, Silver City, New Mexico, 6,000 feet.

INSOLATION. DIATHERMANCY OF AIR. ALPINE RESORTS

Associated with diminished atmospheric pressure are other important and inseparable atmospheric qualities which contribute largely

to the resultant influence on man's welfare in the higher altitudes. These other qualities have a special influence on pulmonary tuberculosis and should be recognized in estimating the effect on patients of this class.

We have, first, greater insolation. The part played by the earth's atmosphere in arresting the sun's rays is very important and second only to the influence of the atmosphere of the sun itself in arresting the radiation of light and heat from the sun. Slight changes in the sun's atmosphere would speedily alter the terrestrial climate. On the earth's surface at sea level the energy of light of the sun and that of the heat rays are considerably less than at the higher altitudes and recent measurements are of great interest and practical value.

Dr. Julius Hann, the great meteorologist of Vienna, has noted that on the lower plains thirty to forty per cent of the total amount of the sun's heat was absorbed by the earth's atmosphere, whereas at the summit of Mt. Blanc, at 15,730 feet (4,810 meters) elevation, nearly one-half of the absorbing mass of the air is lost and the amount of the sun's heat absorbed was not more than 6 per cent. One can readily understand that when the resistance is removed the light rays are more effective than at sea level. The late Prof. S. P. Langley showed by delicate measurements at this height that the blue end of the spectrum grows to many times its intensity at sea level.[1] This marked diathermancy of the atmosphere goes hand in hand with altitude. The increased facility with which the solar rays are transmitted through an attenuated air accounts for the tan and sunburn so readily acquired on mountain tops and this quality is, in the author's opinion, of value in the prevention and treatment of tuberculosis.

Owing to the increased diathermancy of the atmosphere at elevated stations there is a remarkable difference between the atmospheric temperature in the sun and in the shade. At the higher Alpine resorts for tuberculous patients, such as Davos (5,200 feet), St. Moritz (6,000 feet), Arosa (6,100 feet), and Leysin (4,757 feet), the excessive heat in the sun compared with shade temperatures in winter favors the outdoor life during the "invalid's day." It also, incidentally, impresses all newly arrived visitors as a marvellous climatic feature. At St. Moritz, now a fashionable winter resort, ladies find parasols almost a necessity while friends are skating, and those

[1] S. P. Langley: Researches on Solar Heat and Its Absorption by the Earth's Atmosphere. Papers of the U. S. Weather Bureau, No. 15, Washington, 1884, p. 242.

who indulge in this Alpine pastime revel in summer clothing. Although the climate is a cold one it is characterized by great diurnal ranges of temperature, freedom from dust, winds and fogs, and eminently suitable for the climatic cure.

As the snow lies on the ground at these resorts for from three to five months, sleighing, skating, skiing and tobogganing are popular and some of these sports are allowable in suitable cases of tuberculosis. In March or April the snow melts and the roads become slushy and muddy, so that the air becomes very damp, and patients are accustomed to make temporary visits to lower stations, such as Wiesen (4,760 feet), Seewis (2,985 feet), Thusis (2,448 feet), Gais in Appenzell (2,820 feet), or Ragaz (1,709 feet), returning later to the higher stations.[1]

SURGICAL TUBERCULOSIS TREATMENT IN SWITZERLAND

No chapter on high altitude treatment would be complete at the present time without noting the brilliant success of Dr. A. Rollier in the treatment of surgical tuberculosis at Leysin, in the Vaudois Alps, Switzerland. This station has an altitude of about 4,500 feet above sea level. The hospital buildings face the south and are protected by mountain ranges from the cold winds of the north and west.[2] Rollier states that even in midwinter, with snow on the ground, the temperature on the sunny balconies is often as high as 95° to 120° F. Owing to the purity of the atmosphere and the absence of moisture there is little loss of the luminous and caloric radiation of the sun. Rollier established his first hospital for the treatment of tuberculosis of the bones and joints in 1903, but it is only during the last two or three years that his method has attracted so much attention, though Bernard, of Samaden, had practiced it in the pure mountain air of Graubunden in the Engadine; and probably this influenced Rollier to select an elevated site for his hospitals. These are three in number and are located at 1,250, 1,350 and 1,500 meters, or 3,800, 4,100 and 4,500 feet. The exposure of

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[1] See Walter B. Platt, M. D.: The Climate of St. Moritz, Upper Engadine, Switzerland (Trans. Amer. Climat. Ass., Vol. 4, p. 137).

Arnold C. Klebs: St. Moritz, Engadine (Trans. Amer. Climat. Ass., 1906, Vol. 22, p. 15).

[2] See description by John Winters Brannan, M. D., Medical Record, June 7, 1913. Also Rollier, Paris Médical, January 7, 1911, and February, 1913. The author is indebted to Dr. Brannan for his data and to Dr. Rollier for the illustrations and descriptions of his method.

the patient to the sun is the essential feature and after three to ten days of acclimatization indoors he begins with five minute exposures of the feet, five times a day. This is steadily increased as pigmentation appears until finally the entire surface of the body is exposed from sunrise to sunset. The head is, however, protected with white caps and shaded glasses. With the development of the pigmentation the cure progresses until recovery is complete. Dr. Rollier has sent us photographs of a boy who had 32 foci of tuberculosis, even the lungs being involved. This boy was considered cured after fifteen months of treatment. See plate 26.

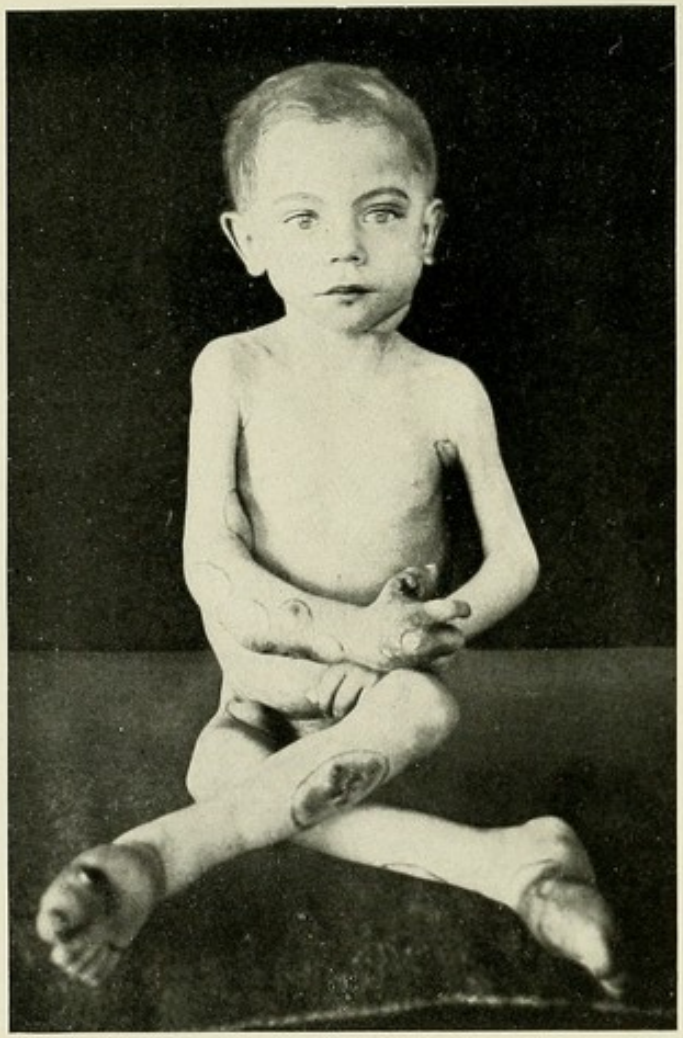
In another case there were multiple lesions, including a badly disorganized and anchylosed elbow with seven sinuses and a history of three resections of the joint and forearm. This boy also made a good recovery with complete return of function, full flexion and full extension. See plate 27. Dr. Brannan adds that he has seen many such cures at " See Breeze " and has kindly furnished photographs of some of these patients. See plate 16.

According to Rollier the pigmentation is the important element in the cure, inasmuch as it affords to the skin a remarkable resistance, favors the cicatrization of wounds and confers a local immunity to microbic infections. On days when there is no sunshine recourse is had to radiotherapy for the adults and the Bier treatment (local lowering of atmospheric pressure) for the children; at all times, whether the sun shines or not, the skin has its bath of air and light.

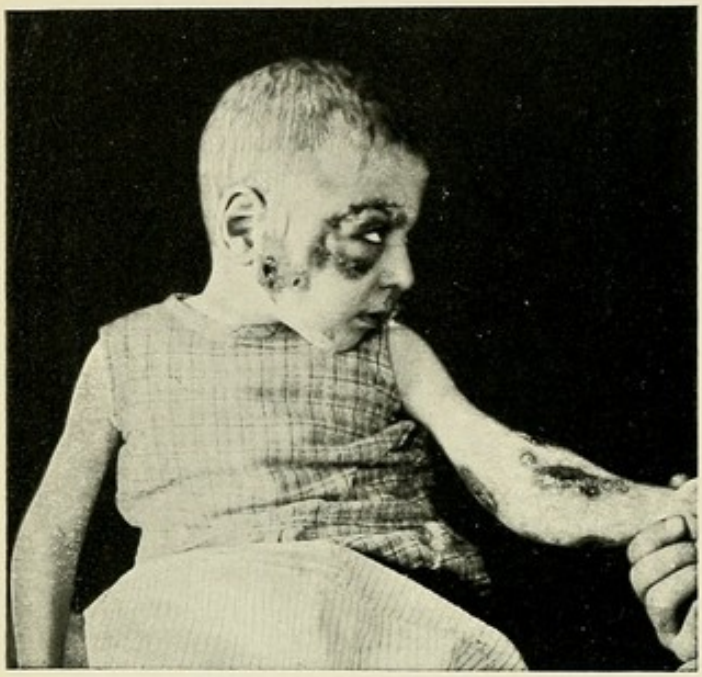
Two hundred beds in Rollier's sanatoria are reserved for children.

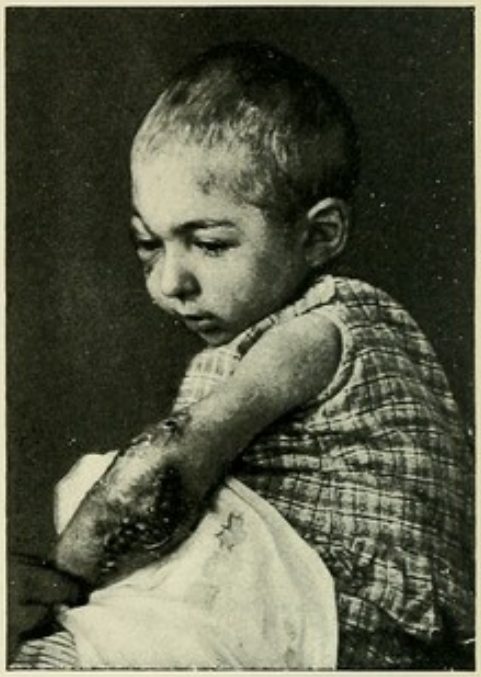
Dr. Rollier presented to the XVII International Medical Congress at London in 1913, a résumé of his method of heliotherapy and refers to eighteen separate communications to medical literature, in which he and his associates have described the method. Among other things we notice that he reports the number of adults having external tuberculosis treated by him as greater than that of children, 522 to 477. The prognosis for the former is as favorable as for the latter and the duration of treatment is never much longer. In Rollier's paper, referred to, all his cases for the past eleven years are tabulated and out of 1,129 patients, 951 are reported cured. Of the total number only three underwent the operation of resection. These were cases of gonorrheal arthritis; one was adult of over fifty years. Two cases of tuberculosis of the foot were treated by amputation; both were adults of over sixty years.

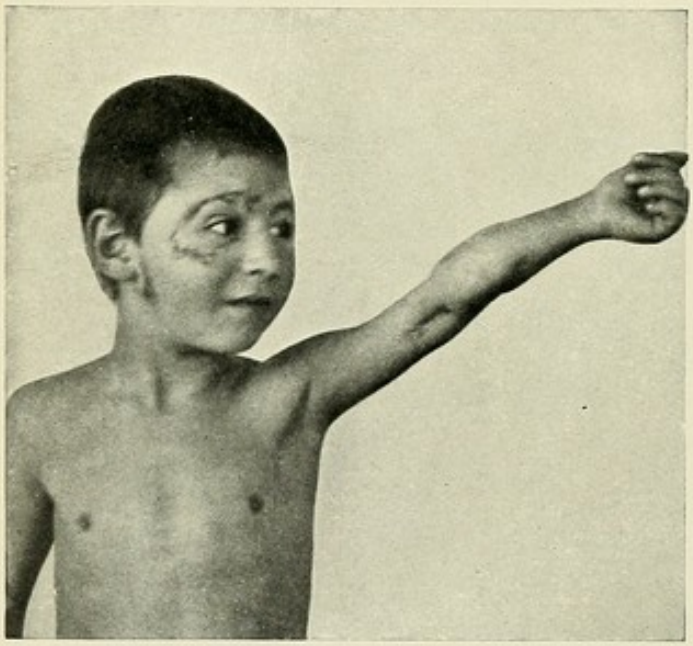
Rollier uses fixation by means of plaster, especially in Pott's Disease, but in all cases insists strenuously that the tuberculous joint

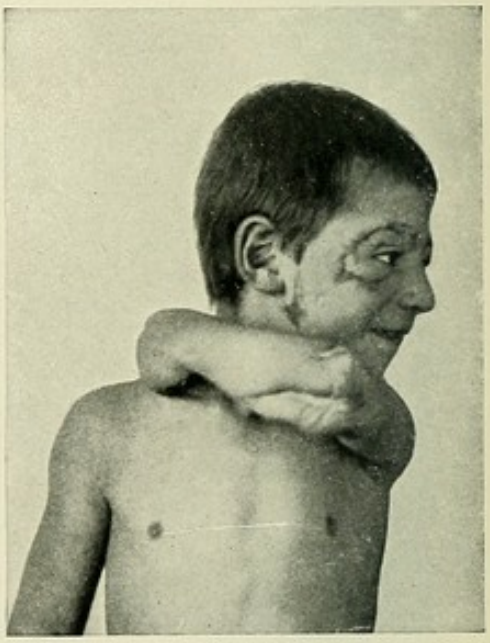


TWO VIEWS OF THE SAME CHILD. THERE WERE 32 FOCI OF LUNG, GLANDULAR AND BONE TUBERCULOSIS; GENERAL CONDITION VERY BAD. AFTER ONE YEAR OF HELIOTHERAPY AT DR. ROLLIER'S SANATORIUM WELL ESTABLISHED CURE. HEALED SCARS AT SIGHT OF OPEN SORES; VIGOROUS.









FOUR ILLUSTRATIONS OF THE SAME CHILD. HE WAS ADMITTED TO DR. ROLLIER'S SANATORIUM, LEYSIN, AT THE AGE OF FIVE, WITH NUMEROUS TUBERCULOUS FOCI IN THE BONE AND PERIOSTEUM AND ABOUT THE RIGHT EYE. THERE WAS TUBERCULOSIS OF THE ELBOW AND RIGHT FOREARM. THREE PREVIOUS OPERATIONS. SEVEN FISTULOUS OPENINGS IN THE ELBOW; SEVEN IN THE FACE. JOINTS IMMOVABLE; GENERAL CONDITION BAD. THE TWO LOWER VIEWS SHOW THAT AT THE END OF ONE YEAR THE OPEN SORE HAD HEALED. CHILD VIGOROUS.

or other site of the disease must not be covered over by any unremovable apparatus so as to interfere with the full exposure to the sunlight. Rollier's last paper goes very fully into the technic of heliotherapy and the reader is referred to this and to the fully illustrated paper in "Paris Médical," February, 1913, in which there are forty-five remarkable photographs covering the most interesting features of this work. It is at present attracting great attention and American physicians can find in the recent review of Rollier's work by Dr. Henry Dietrich, of Los Angeles, California, an excellent summary of its theory and practice.[1]

Rollier,[2] in his address before the Gesellschaft deutscher Naturforscher and Aerzte in Münster in 1912, says:

> It is in surgical tuberculosis that we have seen the best results from heliotherapy, and we have made the treatment of it our life work. As a result of my experience in the use of the light-cure in higher altitudes, based on an experience of nine years, I maintain to-day that the cure of surgical tuberculosis in all its forms, in all stages, as well as at every age of life, can be accomplished.
>
> The closed surgical tuberculosis always heals, if one will only be patient, and above all if one understands how to keep it closed. To transform a closed tuberculosis into an open one means to increase the gravity of the case a hundredfold. A diminution of the vitality of the tissues is the inevitable consequence. . . . . To regard a surgical tuberculosis as a local disease which can be cured by local treatment alone is a ruinous error. On the contrary,

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[1] Journ. Amer. Med. Ass., December 20, 1913, p. 2232.

[2] References: Rollier (Verhandl. d. Gesellsch. f. Kinderheilk. d. 84 Versamml. d. Gesellsch. deutsch. Naturforsch. u. Aerzte in Münster), 1912. A report of 650 cases in which 355 patients were adults and 295 children. There were 450 cases of closed surgical tuberculosis and 200 cases of open surgical tuberculosis. In the cases of closed surgical tuberculosis 393 patients were cured, 41 improved, 11 remained stationary, and 5 died. Of the patients with open surgical tuberculosis, 137 were cured, 29 improved, 14 remained stationary, and 20 died.

Rollier and Rosselet: Sur le rôle du pigment épidermique et de la chlorophylle (Bulletin de la Soc. des sciences nat. 1908).

Rollier and Hallopeau: Sur les cures solaires directes des tuberculoses dans les stations d'altitude. Communication à l'Académie de Médecine, Paris (Bulletin de l'A. d. Méd., 1908, page 422).

Rollier and Borel: Héliothérapie de la tuberculose primaire de la conjonctive (Rev. méd. de la Suisse romande, 20 avril 1912).

Witmer, T. and Franzoni, A.: Deutsch. Zeitschrift für Chirurgie, No. 114.

P. F. Armand-Delille: L'Heliotherapie, Masson et Cie, Paris, 1914.

P. Vignard and P. Jouffray: La Cure Solaire des Tuberculoses Chirurgicales, Masson et Cie, Paris.

it is a general affection which requires general treatment. Of all infectious diseases it is the one in which the individual resistance plays a deciding part. Our first effort, therefore, is directed to improve general conditions and thus to bring about a healing of the local focus by treatment of the entire system. A rational local treatment is necessary as well, provided it is not too one-sided.

In cases of spondylitis, or Pott's disease, the children wear jackets having a large fenestrum cut anteriorly, as the vertebræ in children are not much further removed from the surface of the abdomen than from that of the back. After healing is verified by X-ray a celluloid corset is worn. One or two years are required for the cure. Plate 29 shows a girl thus cured of pronounced Pott's disease with gibbosity, and paraplegia and muscular atrophy. There was complete healing after fifteen months of the solar cure which the illustration well shows.

CASES OF HIGH ALTITUDE TREATMENT

As illustrations of the good effect of high altitude treatment, two cases from the practice of the late Dr. Charles Theodore Williams, of London, may be cited. They were both cured at St. Moritz (6,000 feet).

Miss C., aged 18, was first seen by Dr. Williams, July 20, 1887. She had lost a sister from tuberculosis and she had a history of cough and expectoration for five months and wasting and night sweats for two months; total loss of appetite and aspect very pallid. Slight dulness, crepitation in first interspace to the right. Ordered to St. Moritz for the winter. In the spring the patient spent six weeks in Wiesen, elevation 4,760 feet. She entirely lost her cough and expectoration, gained twenty-four pounds in weight and became well bronzed, looking the picture of health. Her chest increased enormously in circumference and measured, on full expiration, five inches more at the level of the second rib than before she left England. She stated that she had burst all her clothes. Careful examination at the end of eleven months, when these later notes were taken, showed great development of the thorax and hyper-resonance everywhere, but no abnormal physical signs. After more than three years in England the chest measurement had somewhat decreased.

Another patient, Miss R., aged 21, was seen in November, 1879, with a history of cough with expectoration, loss of flesh, night sweats, pain in the left chest and evening pyrexia of a month's dura-

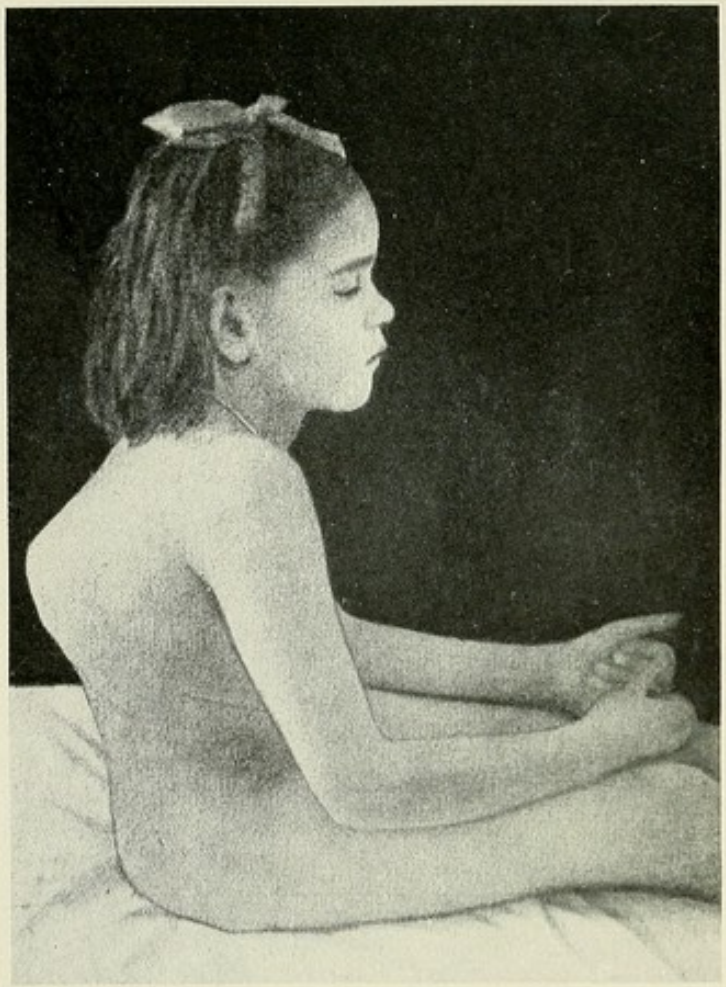

FIG. 1. POTT'S DISEASE WITH PRONOUNCED DEFORMITY, PARAPLEGIA AND MUSCULAR ATROPHY. CLINIC OF DR. ROLLIER, LEYSIN.

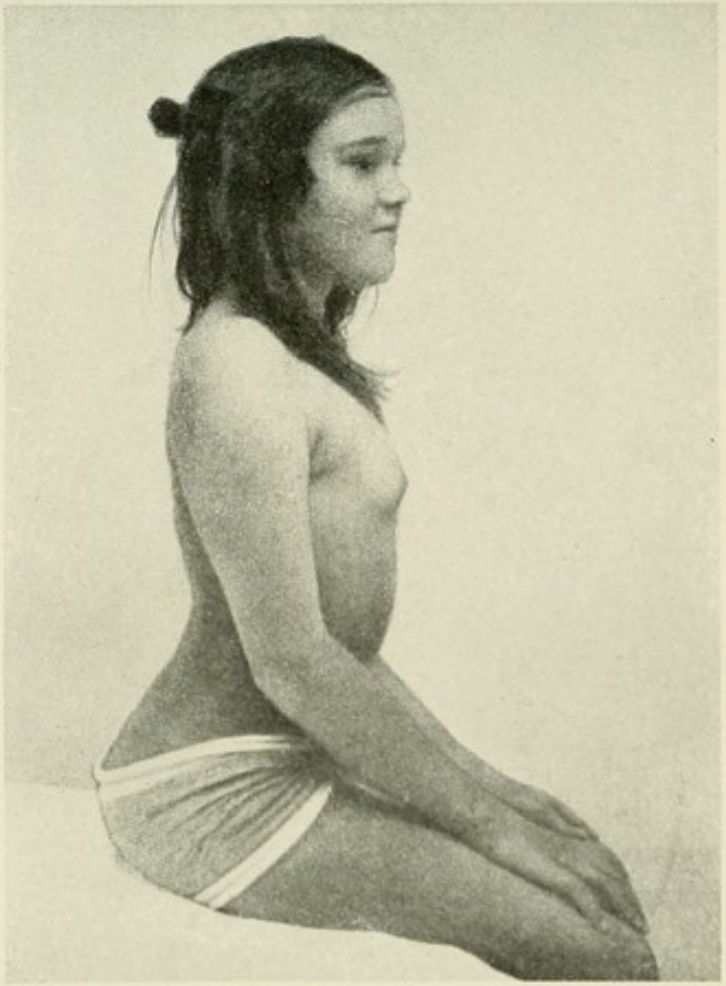

FIG. 2. THE SAME PATIENT AFTER FIFTEEN MONTHS OF HELIOTHERAPY. CORRECTION OF DEFORMITY. COMPLETE RESTORATION OF MUSCULATURE AND GENERAL STATE. CLINIC OF DR. ROLLIER.

FIG. 1. HELIOTHERAPY AND IMMOBILIZATION IN PLASTER FOR SURGICAL TUBERCULOSIS. BALCONY OF DR. ROLLIER'S SANATORIUM, "LE CHALET," LEYSIN, SWITZERLAND. THE JACKETS HAVE LARGE OPENINGS TO ALLOW ACCESS OF SUNLIGHT TO THE DISEASED SPINES. SOME PATIENTS IN DORSAL POSITION; OTHERS IN VENTRAL POSITION.

FIG. 2. CHILDREN WHO CAME TO DR. ROLLIER VERY SICK NOW INDULGE IN WINTER SPORTS. NO CLOTHING BUT CAPS AND LOIN CLOTHS. NOTE THE MUSCULATURE OF THE CHILDREN FORMERLY SUBJECTS OF COXALGIA, ARTHRITIS, PERITONITIS AND ADENITIS.

tion. Dullness and deficient breath sounds were detected close to the left scapula. After three years of unsuccessful treatment in England, during which time two winters were spent at Hyères, on the Mediterranean, losing ground and growing thinner and showing evidence of commencing disease in the opposite lung, she was sent for the winter to St. Moritz. She returned the following May vigorous and well bronzed, having taken plenty of exercise, skating, walking, and tobogganing. She had lost all cough and had gained much strength. The chest measurement showed an increase of one inch. The whole thorax was found hyper-resonant and no physical signs of consolidation could be detected. After eleven years of residence subsequently in England, she was free from chest symptoms.

In this case, notwithstanding the improvement following two winters spent at Hyères, at sea level, the disease was not arrested and increased the following year. But during one winter's residence at St. Moritz, elevation 6,000 feet (diminished atmospheric pressure and out-door life with winter sports), there was complete arrest of the disease, as the experience of eleven years with absence of physical signs testifies.

There is a wealth of clinical material to show the advantages of high altitude treatment at the well-known European and American resorts. Sir Hermann Weber, of London, and his son, Dr. F. Parkes Weber, have had a long and favorable experience in the treatment of pulmonary tuberculosis in high altitudes and they support Dr. C. T. Williams in a higher estimate of treatment of this disease at high elevations as contrasted with results at the sea level.

Twenty-five years ago Sir Hermann Weber stated that out of 106 tuberculous patients sent to high altitudes, 38 were cured, either permanently or temporarily, 16 were stationary or but slightly improved and 10 deteriorated. More than half of the cases in the first stage were cured.

The American statistics of Drs. Samuel A. Fisk,[1] W. A. Jayne,[2] S. E. Solly,[3] Charles Denison and S. G. Bonney, all of Colorado,

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[1] Fisk, Samuel A.: Concerning Colorado (Medical News, Sept. 16, 1899); Climate of Colorado (Trans. Amer. Climat. Ass., 1888, p. 11).

[2] Jayne, W. A.: Climate of Colorado and Its Effects (Trans. Amer. Climat. Ass., 1888).

[3] Solly, S. E.: Invalids Suited for Colorado Springs (Trans. Amer. Climat. Ass., 1888, p. 34).

are certainly convincing as to the effect of high altitude treatment in the cure of pulmonary tuberculosis.[1]

Solly said in 1888, "Taking the medical profession throughout the world, it is unquestionable that a large majority of those who have made a study of the subject believe that where a change is made, a change to an elevated country is the most likely to benefit a consumptive."

Solly lived for thirty-three years in Colorado after having removed, as a tuberculous invalid, from England. Every one of the physicians mentioned above went to Denver or Colorado Springs as a tuberculous patient, recovered his health there, acquired a reputation and successful practice during fifteen to thirty years of residence and the majority are alive to-day (1913). Those who died succumbed to other affections.

According to Solly, 76 per cent of all patients, good, bad and indifferent, and 89 per cent of those in the first stage that undergo climatic treatment in Colorado are benefited. Would such patients as we have mentioned have derived equal and as lasting benefit at Alpine Stations, such as Davos or St. Moritz, which have a corresponding altitude and an equal barometric pressure? Judging from recorded clinical experience, we believe that they probably would have done equally well. We can never know absolutely. Would they have done equally well at sea-level or at very moderate altitude? None of the physician-patients whose names are quoted would admit it.

Dr. Solly, with his inimitable humor once remarked, "If I were living in London to-day, I'd be dead." In all human probability most, if not all of them, are fair examples of the curative power of the Colorado climate.

Of late there have been dissenting voices, challenging some of the cardinal principles involved in the altitude treatment of tuberculosis. Not only altitude, with its concomitant rarefied atmosphere, but even sunlight itself which lightens the heart of every invalid, have both been denied the value so generally assigned them in tuberculo-

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[1] Charles Theodore Williams: Aerotherapeutics, or the Treatment of Lung Diseases by Climate. The Lumleian Lectures, 1893; Macmillan, 1894, pp. 111-179.

Charles Denison: Dryness and Elevation the Most Important Elements in the Climatic Treatment of Phthisis (Trans. Amer. Climat. Ass., Vol. 1, 1884, p. 22).

therapy. These discordant notes find utterances among those who have been compelled to treat the poorer class of consumptives in our cities at the seaboard and who have obtained some excellent results. Stress is laid on the beneficial influence, for example, of cold.[1] The fact that patients improve more in winter than in summer is cited to prove that "cold air in itself seems to cure in a manner which nothing else can accomplish. * * * Sunshine is not essential—excellent results may be obtained in climates where the sun is rarely seen. Mere outdoor living seems to be the essential element, and yet there does not seem to be any doubt that quicker results are obtained in the cold season than in the summer."

EFFECT OF COLD AIR

There is truth in the proposition that cold air is better for the consumptive than heated air. It is usually purer and is unquestionably more stimulating to the vital forces. Warm sleeping rooms are positively bad because of deficient ventilation. Warmth debilitates and opens the way to bacterial invasion. Hot weather is relaxing, while moderate cold, or greater cold with proper safeguards, acts as a tonic and fortifies the well and sick alike against disease.

The good effect of cold air in tuberculosis is commonly noted by physicians and patients. The following extract from a letter from a tuberculous patient, dated Saranac Lake, New York, February 19, 1908, is interesting:

> I have not felt the cold up here this winter as I feared I might, although the mercury has nearly disappeared on one or two memorable nights. 46° below zero is the coldest I have seen it but it was reported 50° below in the village. I am quite used to the cold now as I sit out on the porch all day and have not missed a day yet; but there is one redeeming feature about the cold up here and that is that zero weather does not seem nearly so cold as 20° above in Philadelphia. I really do not begin to feel it until it gets to 20° below, although it is usually too cold to use my hands even in milder weather. J. D.

This patient was 22 years old, had been at Saranac fifteen months and is reported perfectly well and weighs 180 pounds. He is apparently cured. He remains well, Nov., 1913.

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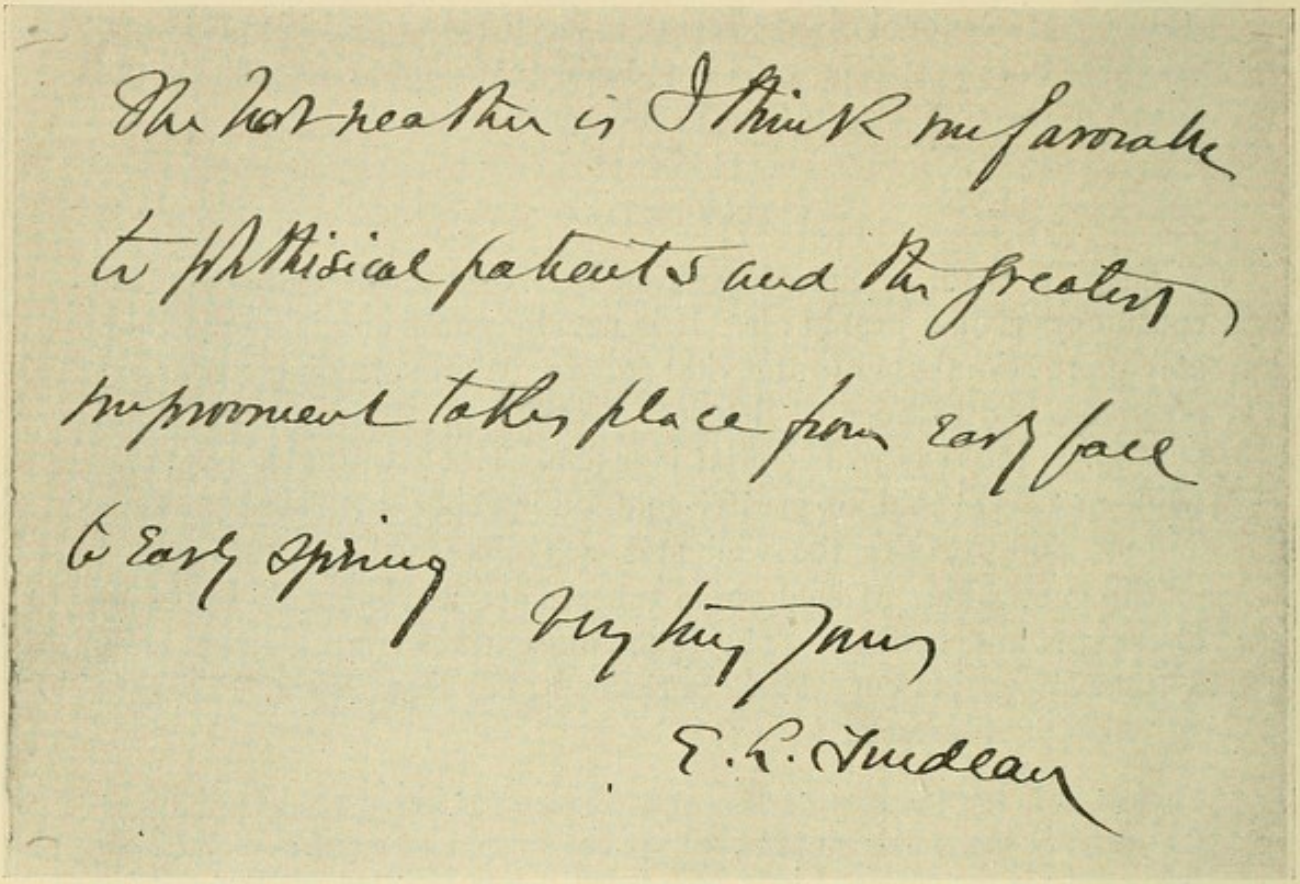
[1] Editorial, American Medicine, Philadelphia, January 20, 1906.

See A. D. Blackader, M. D.: The Advantages of a Cold, Dry Climate in the Treatment of Some Forms of Disease (N. Y. Med. Journ., Aug. 3, 1912).

The minimum temperature at Saranac Lake for 1912 was —32° F. on January 25, and the maximum was 88° F. on July 10. The mean temperature was 40.98° F. The total precipitation was 43.19 inches, with a total snowfall of 124.24 inches. Clear days, 153; partly cloudy, 77; cloudy, 136.

The extract here reproduced from a letter dated Saranac Lake, July, 1886, is interesting. It was addressed to the author.



The best and clearest statement of seasonal influence on body weight of consumptives that we know of was made by Dr. N. B. Burns, of the North Reading State Sanatorium, Massachusetts. His observations are based on one thousand patients during three years. Fully forty per cent of the cases admitted to this sanatorium were of the far advanced and progressive type. It was noted that August, September and October show that the largest percentage of patients gaining, while the three months immediately preceding show the opposite.

Dr. Burns also charted the aggregate gain in pounds of the male patients treated at North Reading, December, 1911 to 1912, inclusive. There was a rise in January and February, 1912, to 850 pounds for 76 patients which was maintained well through March and April.

NORTH READING STATE SANATORIUM, MASSACHUSETTS

TABLE ONE

N B. BURNS, M. D.

PER CENT	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
PATIENTS GAINING	64.5	59.4	42.7	47.2	42.0	44.2	46.9	71.9	74.9	66.4	60.7	64.9
PATIENTS LOSING	27.9	35.4	50.2	44.5	50.7	50.4	47.6	27.3	17.3	25.5	29.8	27.8
PATIENTS STATIONARY	7.6	5.2	7.1	8.3	7.3	5.4	5.5	0.8	7.8	8.1	9.5	7.3

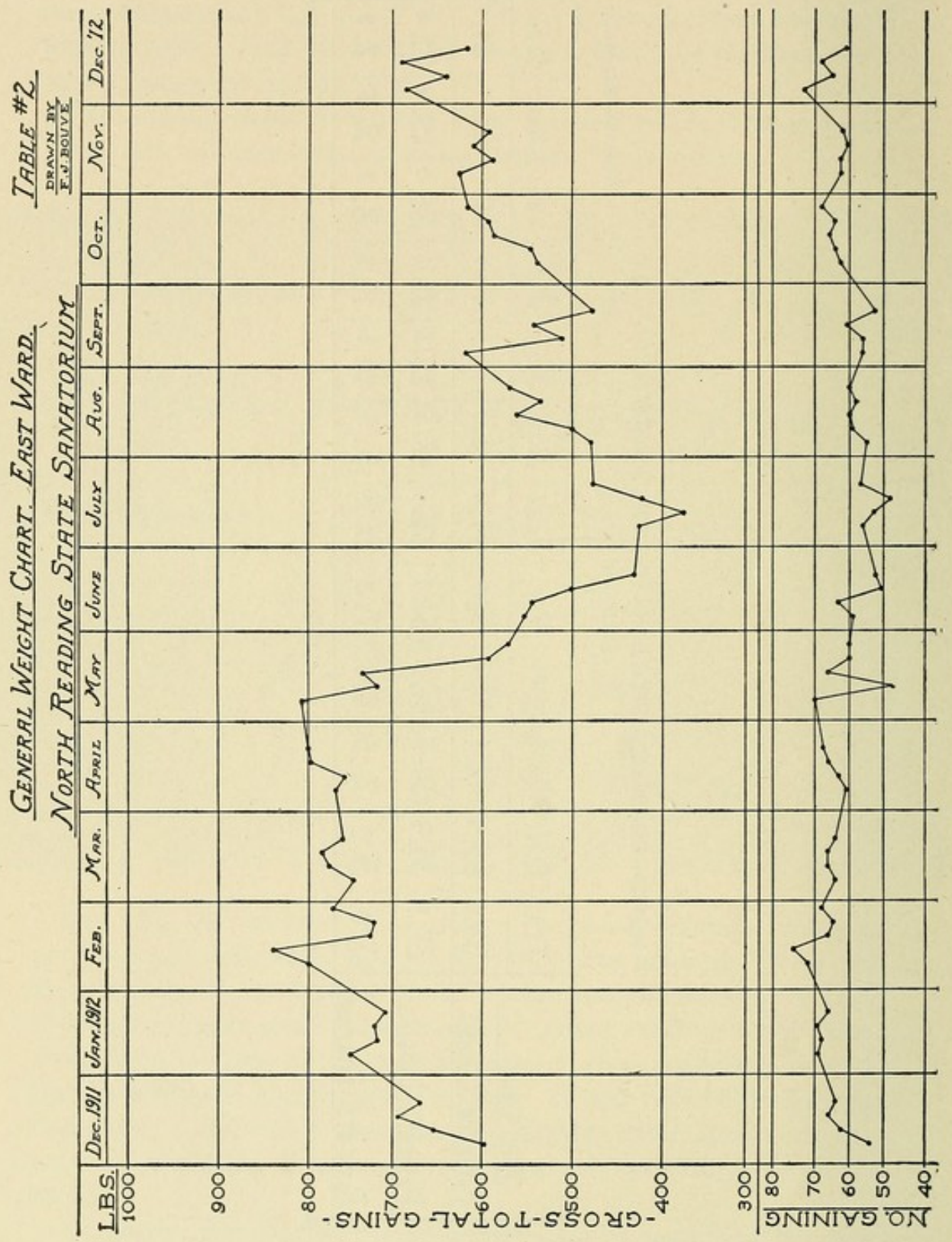


TABLE #2
GENERAL WEIGHT CHART. EAST WARD.
NORTH READING STATE SANATORIUM
DRAWN BY F.J. BOUVE
LBS.
1000
900
800
700
600
500
400
300
-GROSS-TOTAL GAINS-
NO. GAINING
80
70
60
50
40
DEC. 1911
JAN. 1912
FEB.
MAR.
APRIL
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC. '12

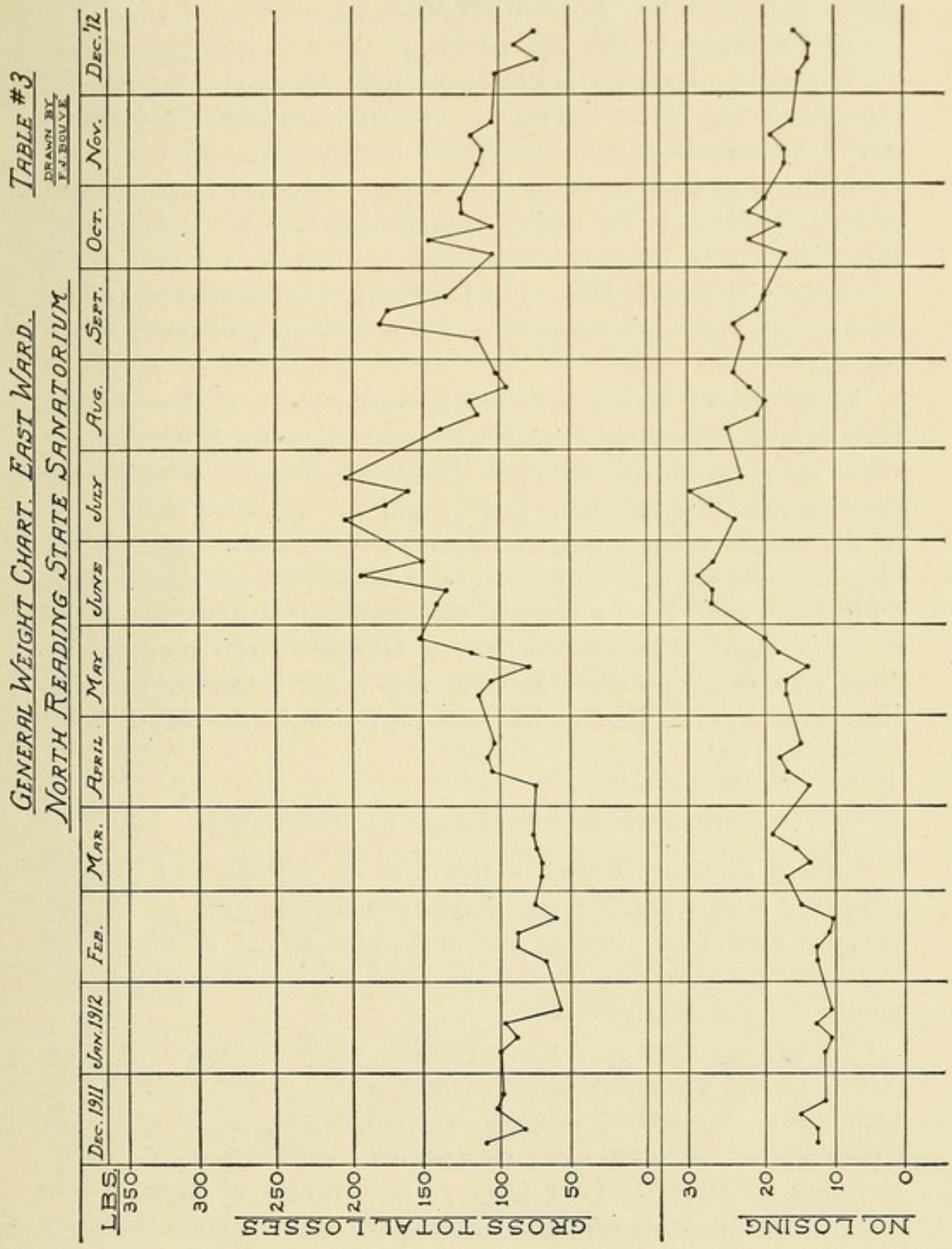


TABLE #3
GENERAL WEIGHT CHART. EAST WARD.
NORTH READING STATE SANATORIUM
DRAWN BY F.J. BOUVE
LBS.
350
300
250
200
150
100
50
0
GROSS TOTAL LOSSES
30
20
10
0
NO. LOSING
DEC. 1911
JAN. 1912
FEB.
MAR.
APRIL
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC. '12

There was a subsequent sharp decline in May, the index dropping 250 points. This fall continued without interruption in June, to culminate July 11, at the low point for 1912.

The conclusion of this study was:

Phthisical patients are apt to lose rapidly in weight and general condition in May, June, and the first two weeks in July, which season constitutes an unfavorable and critical period.

Phthisical patients make an extraordinary recovery in weight and general condition in the month of August, which is a surprisingly favorable time of the year.

August, September, January and February are the most propitious months for obtaining successful results in treating pulmonary tuberculosis.

Forced feeding in the unfavorable season seems to have availed very little in limited number of cases studied at North Reading.

We have already referred to the beneficial influences of the Arctic summer climate (see pages 39-42), and we attributed much of it to the perpetual sunshine; consequently we cannot agree to the illogical statement that sunshine is not essential. We believe that the "Fireside Cure" has no place in the treatment of tuberculosis and we must admit that whereas only a few years ago the cold air fiend, who slept with windows wide open in the coldest winter, was considered a crank, he now has been proved to be the only sensible one among us.[1]

EXPANSION OF THORAX AT HIGH ALTITUDES

Without dwelling further at this time on the effect of cold air compared with warm air on tuberculous disease (see pp. 28, 40, 71), we must note some of the undeniable effects of diminished atmospheric pressure on physical development and especially on the thorax and pulmonary tissue.

One striking change is the expansion of the thorax in various directions and a corresponding increase in the mobility of the thoracic walls. We have previously referred to one case in which the circumference increased five inches during a residence at St. Moritz, elevation 6,100 feet. (See page 74.) Changes of from one to three inches are more commonly noted even at much more moderate elevations. These changes are conveniently recorded by means of

[1] American Medicine, *loc. cit.*

the instrument known as the cyrtometer which gives accurate tracings for recording the progress of the patient.[1]

Inasmuch as tuberculous patients in whom the disease is actively progressing show a shrinking of the perimeter *pari passu* with the advance of the disease, and those who are recovering show an increasing circumference, it is a fair inference that the physiologic increase in thoracic measurements due to residence in the higher altitudes is an advantage in the prevention and treatment of pulmonary tuberculosis. Man is not adapted to live permanently at altitudes above 13,000 to 16,000 feet (4,000-5,000 meters), but at somewhat lower elevations as, for instance, at 10,000 feet we have some thriving cities such as Leadville and Cripple Creek in Colorado, and Quito in Equador, elevations 10,000 and 9,350 feet (3,000 and 2,850 meters). The altitude of the permanent habitations in the Ortler Alps is about 5,450 feet (1,640 meters), and that of the highest health stations from 5,000 to 7,000 feet (Arosa). It is a well-known fact that the Indians of the Andes, the Swiss guides, the Tyrolese hunters and other mountain dwellers have a large thorax with correspondingly deep inspiratory power and remarkable endurance.[2] The increased respiration and the quickening of the circulation promote health and vigor in mountain races and comparisons between the highlanders and those in deep and flat valleys are always in favor of the former. All observers have remarked on the immunity from disease, and especially scrofulous and tuberculous disease, characteristic of mountain races, provided they live in the open, avoid overcrowding, have sufficient and suitable food and observe ordinary hygienic methods of life. Failure in this respect provides an opening for tuberculosis which, as we well know, is the scourge of the North American Indian and his relatives in Mexico and South America. Even in Quito, that city of remarkable equability, where it is perpetual spring, tuberculosis has effected an entrance, and enters largely into the mortality lists.[3] In Bogota, South America, in La-Paz, Mexico (elevation 11,000 feet, 3,360 meters) and in other densely populated towns in these countries, the later records show increasing numbers of cases of tuberculosis. This fact, however,

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[1] See Minor, Charles L.: The Cyrtometer: A Neglected Instrument of Pulmonary Diagnosis and Prognosis (Trans. Amer. Climat. Ass., 1903, p. 221).

[2] "Mexican Indians, though of medium height, have unusually large and wide chests, quite out of proportion to their size." Jourdanet.

[3] Jacoby: Thèse de Paris, 1888. Quoted by Huggard.

should not afford the slightest ground for controverting the general proposition that life at altitudes of from 3,000 to 6,000 feet favors immunity from tuberculosis and the cure of the disease in suitable cases.

CHOICE OF CASES FOR HIGH ALTITUDE

The question then arises, what are suitable cases for altitude treatment? What kind of patients may be sent to stations of lower barometric pressure?

In choosing a location, the late Dr. F. I. Knight, of Boston, formulated some opinions based on his long experience.[1] He limited the age of those resorting to altitudes to fifty years. In temperament he preferred the phlegmatic to the nervous, with an irritable heart, frequent pulse, and inability to resist cold; and with the latter we must be careful not to include those who show nervous irritability from *disease,* not temperament, as they are generally benefited in high places. As regards disease, he first considered cases of early infection of the apices of the lungs with little constitutional disturbance, and, although these generally do well under most conditions, yet considerable experience assured him that more recover in high altitudes than elsewhere.

It is best to begin with low altitude in patients with more advanced disease showing some consolidation but no excavation; also when both apices or much of one lung is involved and the pulse and temperature are both over 100.

Hemorrhagic cases, early cases with hemoptysis and without much fever are benefited by high altitudes. Patients with advanced disease, those with cavities or severe hectic symptoms should not be sent to high altitudes. A small, quiet cavity is not a counter-indication; hectic symptoms are counter-indications.

This accords with the latest report from the U. S. Public Health Service Sanatorium at Fort Stanton, New Mexico, altitude 6,231 feet. Dr. F. C. Smith reports 56 deaths from pulmonary hemorrhage in a total of 524 patients since the hospital was opened in 1899. His conclusion is that pulmonary hemorrhage is not more frequent at high altitude than at sea level, but the results are perhaps more often serious, especially in those with impaired circulation.[2]

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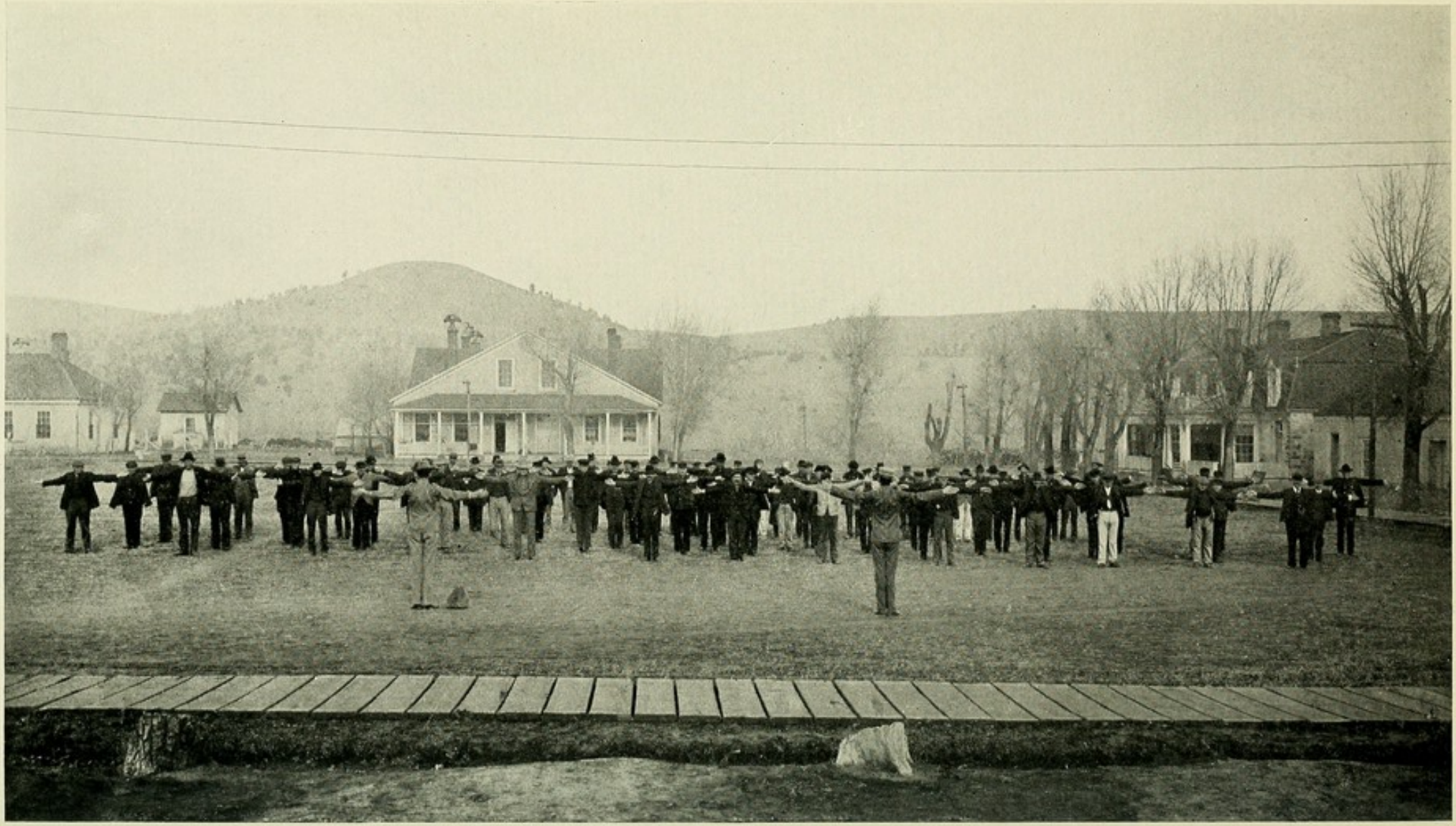
[1] Trans. Amer. Climat. Ass., 1888, p. 50.

[2] Public Health Reports, U. S. Public Health Service, No. 51, by F. C. Smith, Passed Ass't Surgeon, Washington, 1910. See also Report No. 93, Washington, 1912.

SNOW SCENE AT UNITED STATES PUBLIC HEALTH SANATORIUM, FORT STANTON, NEW MEXICO. HOUSE AT RIGHT, WITH PORCH, QUARTERS OF OFFICER IN CHARGE. ROW IN CENTER SETS OF QUARTERS USED BY JUNIOR OFFICERS AND OTHERS



TUBERCULOSIS SANATORIUM OF THE UNITED STATES PUBLIC HEALTH SERVICE, FORT STANTON, NEW MEXICO. AMBULANT SICK CALL.
PATIENTS TAKING BREATHING EXERCISES

Patients in an acute condition should not be sent. Cases of fibroid phthisis, in Dr. Knight's opinion, are not suitable. Convalescents from pneumonia or pleurisy are usually well suited for elevated regions. Advanced cases of tubercular laryngitis, if good local treatment and freedom from dust can be obtained, may do no worse in elevated regions than elsewhere.

In cases complicated by cardiac dilatation we cannot advise altitude; but a cardiac murmur resulting from a long-past attack of endocarditis with no sign of enlargement or deranged circulation should not prevent. Nervous derangements of the heart are usually counter-indications.

The observations made at the United States Public Health Sanatorium at Fort Stanton, New Mexico, by Surgeon F. C. Smith, of the service are commended as a valuable contribution to the Relation of Climate to the Treatment of Pulmonary Tuberculosis. This sanatorium is open to sailors in the merchant marine and they are transferred from the twenty-two marine hospitals on the coasts and rivers to this admirable inland sanatorium. It was found that the results have been nearly three times as good in the cases which left the home stations, *i. e.*, the local marine hospitals, without fever as in those who had a temperature of 38° C. (100.4° F.) or more within two weeks of departure. The deaths in those leaving afebrile were to those leaving with fever as 22 to 59; the arrests, as 19 to 7½; the apparent cures, as 10 to 3. Dr. Smith holds that the case that should be sent to a distant climate immediately upon diagnosis is exceptional and he also adds that neglect to make an early diagnosis does not warrant precipitate haste in sending the victim away when it is finally established. The psychologic moment for a climatic change is when there is a comparative quiescence of the lung process under treatment at home, when nutrition is improved and further improvement is slow (Francine). Climatic change, however, must sometimes be made, as we will see later on, when the hoped for stage of quiescence does not occur.

Before allowing patients with pulmonary diseases to go long distances or to make any great change to higher altitudes, some caution should be given. In the first place, patients should not make any physical exertion for two or three weeks after arrival. The air may be stimulating, there may be sights to see and many dangerous invitations given, but it is absolutely necessary that the patient should be adjusted to the new atmospheric conditions. Acclimatization is necessary to comfort and safety. In the old days it was accomplished by the slow ride in the stage-coach over the plains. We cannot go back to the

old methods, and therefore we must exercise greater caution. No febrile case should be sent on these journeys or to any elevated resort. Hemorrhage is not a counter-indication to a change of altitude, and it is not any more liable to occur at five to six thousand feet than at sea-level. However, no advanced case of pulmonary tuberculosis should be sent away. Financial considerations are highly important. Expenses are usually underestimated, and the want of sufficient means, the need to economize as regards the necessities, not to speak of the luxuries, of life, is a dreadful handicap, and should bar out many a case that succumbs for want of the very comforts he had left behind. It would be far better for such patients if they should enter some special hospital or sanitarium for consumption, such as are found in most of our Eastern States.

No one should be sent away without definite and satisfactory knowledge of the place to which he is sent, and without a letter of introduction to some favorably known practitioner containing a statement of the main points in the case.

In matters of climate, as in many other fields, it is the man behind the climate who will help the patient, save him from errors and indiscretions, advise him and direct him as to local surroundings, and enable him so to live that his disease shall be arrested.

Some localities favorable for tuberculous patients have already been mentioned. Taking the country as a whole we naturally look to the elevated, sparsely settled regions of Colorado, New Mexico, Wyoming, Montana, Nevada, Utah, Arizona and California. The slopes of the Rocky Mountains and the Great Basin are justly entitled to first choice, provided always that other safeguards than climate are to be had for the protection, the comfort and nutriment of the patient. Texas, especially the central and higher western portion, must be included in this great area. Life in Texas was formerly rather too rough and food and accommodations were too primitive for fastidious people, but now at places like San Antonio and El Paso, these defects have been remedied. The winter climate of Texas is very agreeable, except when the Texas norther descends and holds everything in an icy clasp. However, this is not altogether a disadvantage, if not too severe.

Florida suits some cases of phthisis. The interior of the state is sandy and the winter and spring climate is excellent. The cultivation of orange groves and other agricultural features of the state have given many a patient a profitable occupation that he would never have found elsewhere.

Thomasville, in Georgia, sixteen miles from the Florida line, and Aiken and Camden, in South Carolina, have long had a reputation for the relief of pulmonary affections. Asheville, North Caroline, is more elevated (2,300 feet) and has an excellent "all the year round" climate. Special attention is given to tuberculous patients at this resort, and this is something that cannot be said of all the good places. In Pennsylvania, suitable places are found in the Pocono Mountains, at White Haven, Kane, Cresson, Mont Alto and Hamburg. In New Jersey, there are Lakewood, Brown's Mills, Haddonfield, Vineland, and, for special cases, such as chronic fibroid phthisis, we may advise Atlantic City.

In New York, there are the Adirondacks, especially the vicinity of Saranac; Loomis, in Sullivan County, where there is an excellent sanatorium. In New England, there are institutions at Rutland and Sharon, Massachusetts; Wallum Lake, Rhode Island; Wallingford, Connecticut. But, as we have said before, the choice of a place, whether near home or at a distant point, involves all the questions of diagnosis, of temperament, of financial resources, all of which the physician must weigh as conscientiously as though his own life depended on it.

Of late, English physicians have been making more extended use of the higher Alpine resorts. Among these, Davos Platz, altitude 5,200 feet; St. Moritz, 6,000 feet; Arosa, 6,100 feet; and Leysin, 4,712 feet, are usually chosen. Their chief characteristics are an atmosphere of dry, still, cold, rarefied air; absence of fog, few clouds and very little wind. There is, therefore, strong sunlight with a grateful warmth in the sun's rays.

In selecting cases for treatment by change of climate, we must exercise as much discrimination as in applying any other remedial measure. Indeed, more caution should be used, for the patient will pass out of observation and in most cases the advice given involves the most vital consequences.

CHAPTER V. INFLUENCE OF INCREASED ATMOSPHERIC PRESSURE; CONDENSED AIR

Celsus, in treating of pulmonary tuberculosis in the first century A. D., advocated a change of climate and to "seek a denser air than one lives in."[1]

A few places in California and in Asia Minor are below sea-level.

[1] De Medicina, Paris edition, Delahay, 1855.

But the consequent increased atmospheric pressure in these localities is not in itself worthy of note. Such desolate regions as the Dead Sea, the Mojave Desert, Death Valley, and Salton Lake, California, are entirely unsuited for the tuberculous, and, for obvious reasons, all subterranean pressures are out of the question. Divers and caisson workers become anemic and hence artificial pressures increased beyond the normal at sea level are injurious.

Even the natural variations in atmospheric pressure at any given station may be sufficient to have some appreciable influence, *per se*, on the course of pulmonary tuberculosis. Changes of pressure of 20 mm. (.7874 inches) occasionally take place, but they are comparable to a gradual change of level amounting to only 200 meters (656 feet), and it has been assumed that no appreciable physiologic effects can be attributed to these gradual alterations, at least as far as tubercular diseases are concerned. Hann[1] and Thomas[2] state that in experiments with pneumatic chambers, pressure changes amounting to 300 mm. (11.8 inches) a day have been produced without causing any notable injurious effects upon the sick persons concerned in these experiments.

EFFECT OF BAROMETRIC CHANGES ON THE SPIRITS

As the barometric pressure in any given place falls the cloudiness usually increases, the temperature rises, the wind increases, and precipitation is liable to occur; as the pressure rises the skies clear, the temperature falls and the winds shift to the west or northwest. The spirits and general morale of all patients usually improve with a rising barometer unless prolonged wind storms accompany such a change. Whatever improvement accompanies a rising barometer is due to the stimulus of cold or the return of sunshine and dryer air.

Dr. Charles C. Browning, of Los Angeles, has studied the effect of some atmospheric conditions on tuberculous patients.[3] In his first report it appeared that unseasonable or very sudden changes in temperature influenced temperature of patients, while equal or greater changes occurring slowly did not. Of hemorrhages occurring in groups about four times the number occurred when there

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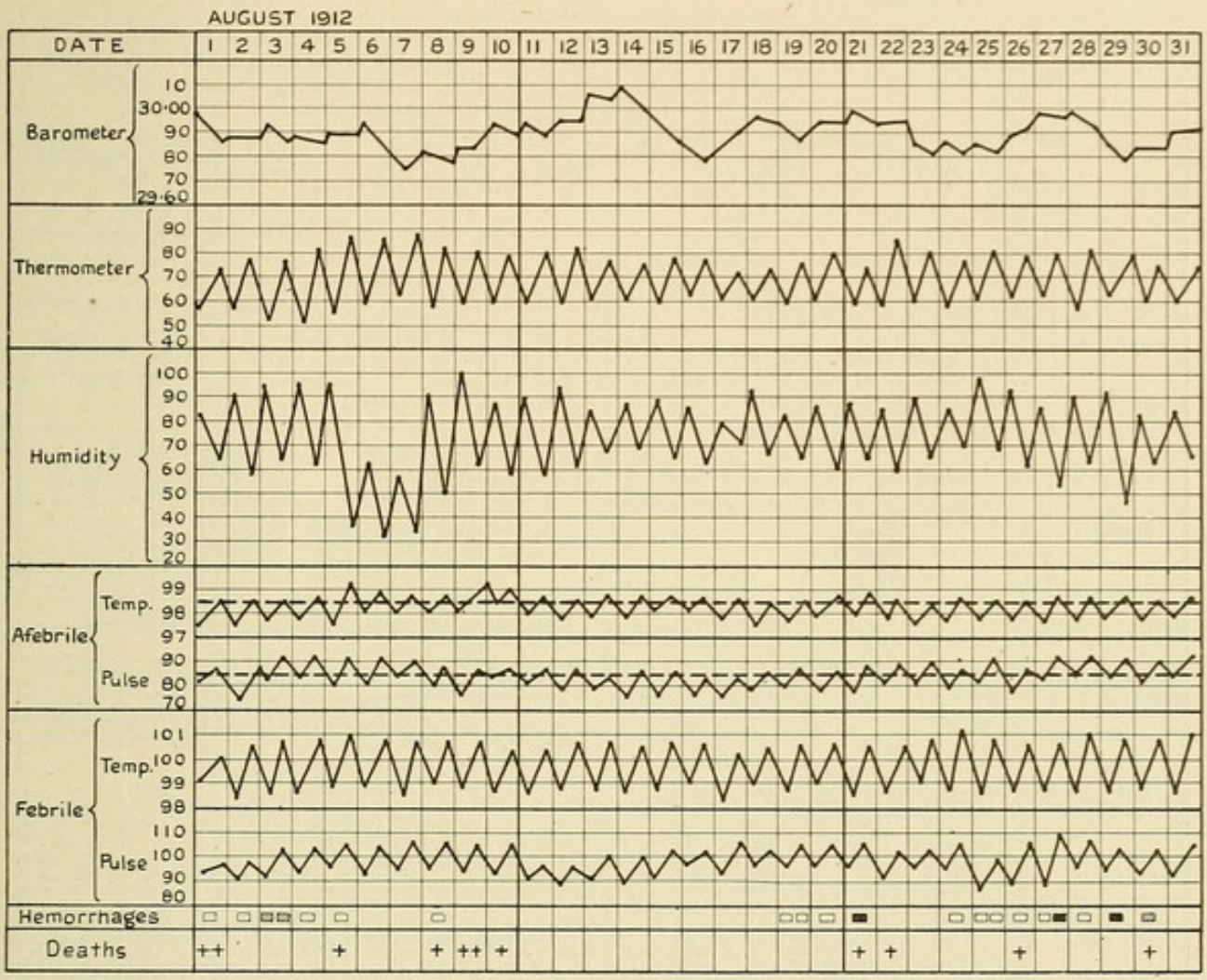
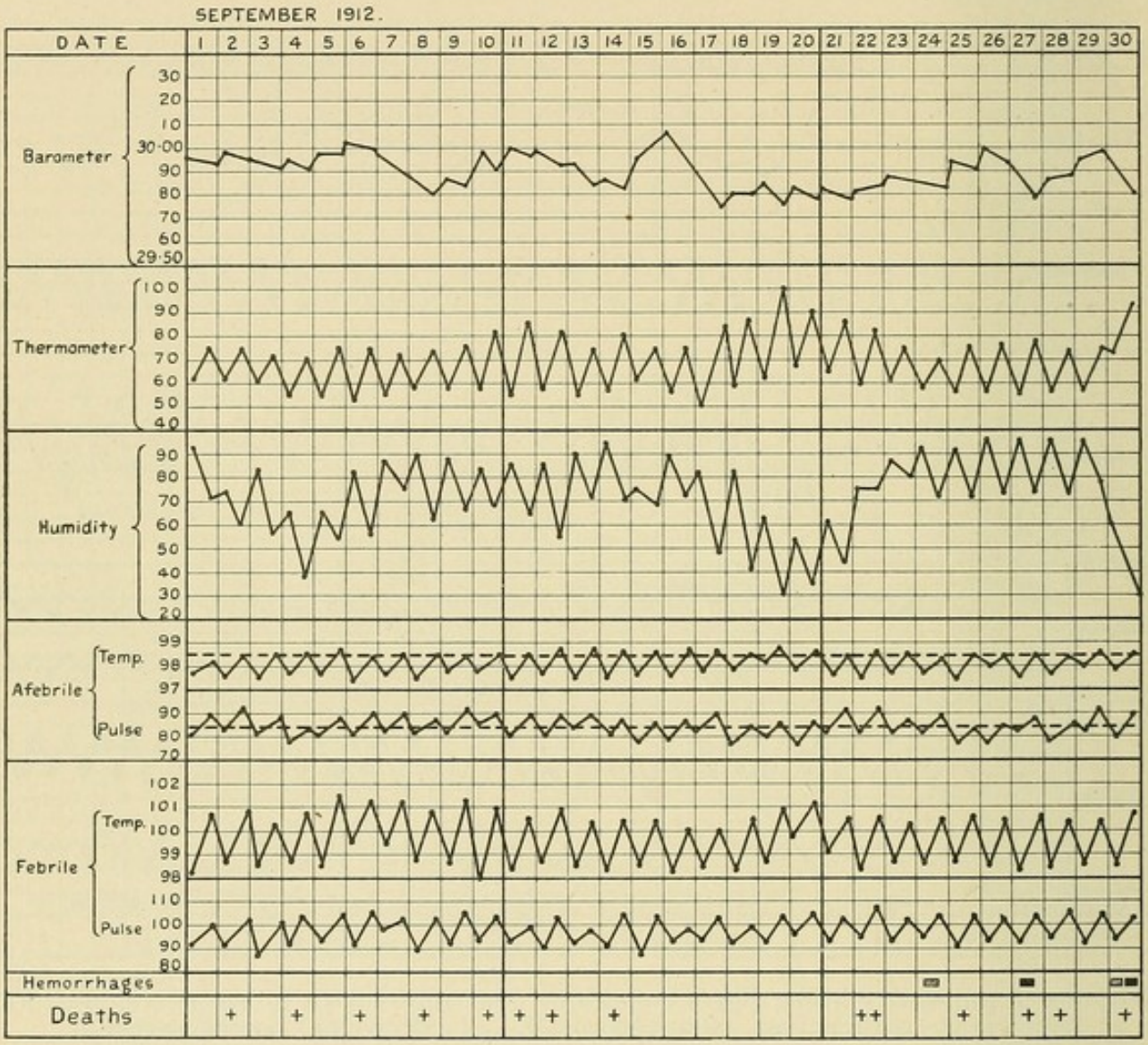
[1] Julius Hann: Handbook of Climatology, Macmillan, 1903, p. 71.
[2] Thomas, in Beiträge zur Allgemeinen Klimatologie, Erlangen, 1872.
[3] Trans. American Climatological Ass., 1908; *idem*, 1913, p. 189.



Relation of pulmonary hemorrhages and deaths from tuberculosis to barometric pressure, temperature and humidity. Courtesy of Dr. C. C. Browning, Los Angeles, Cal.



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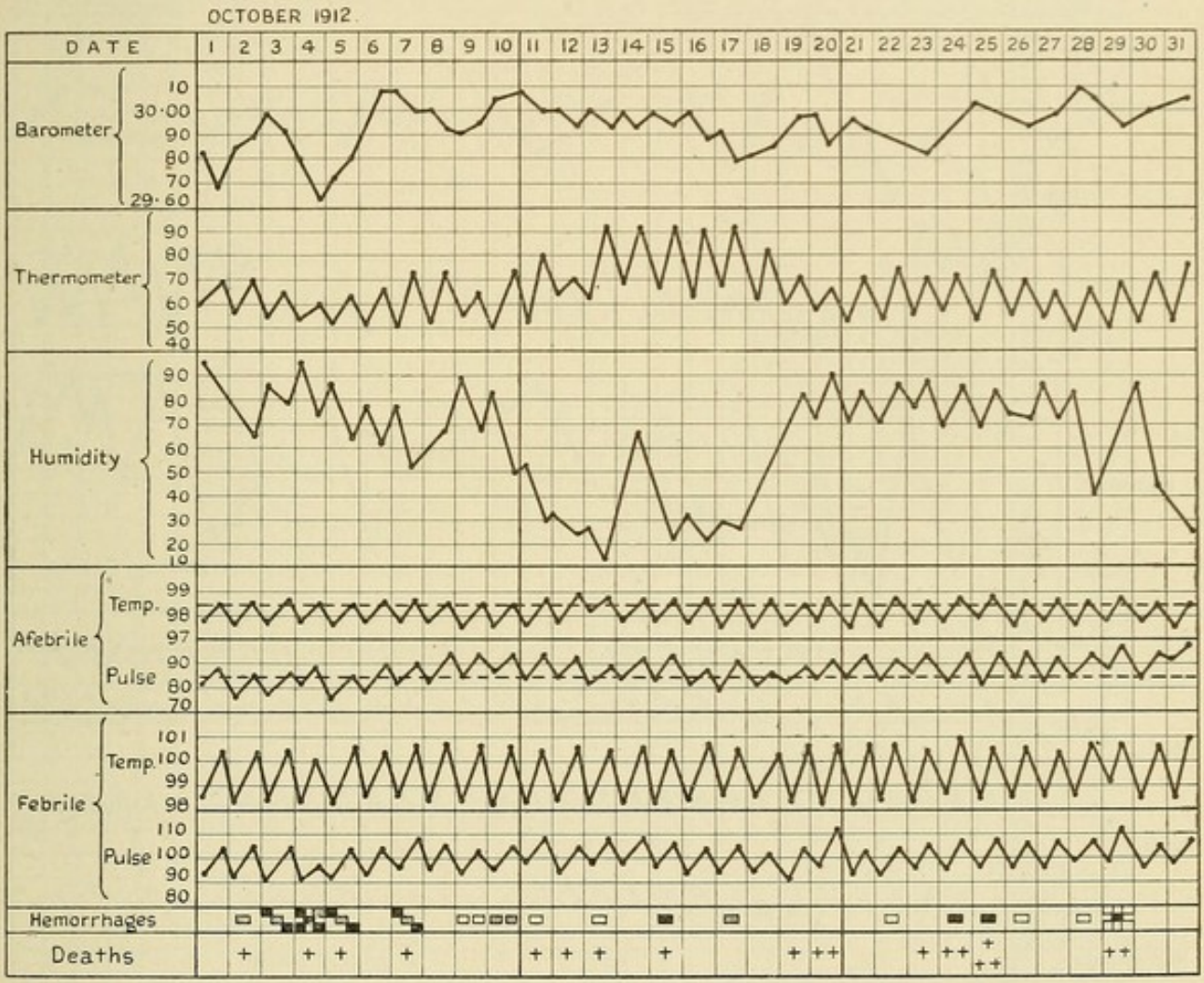

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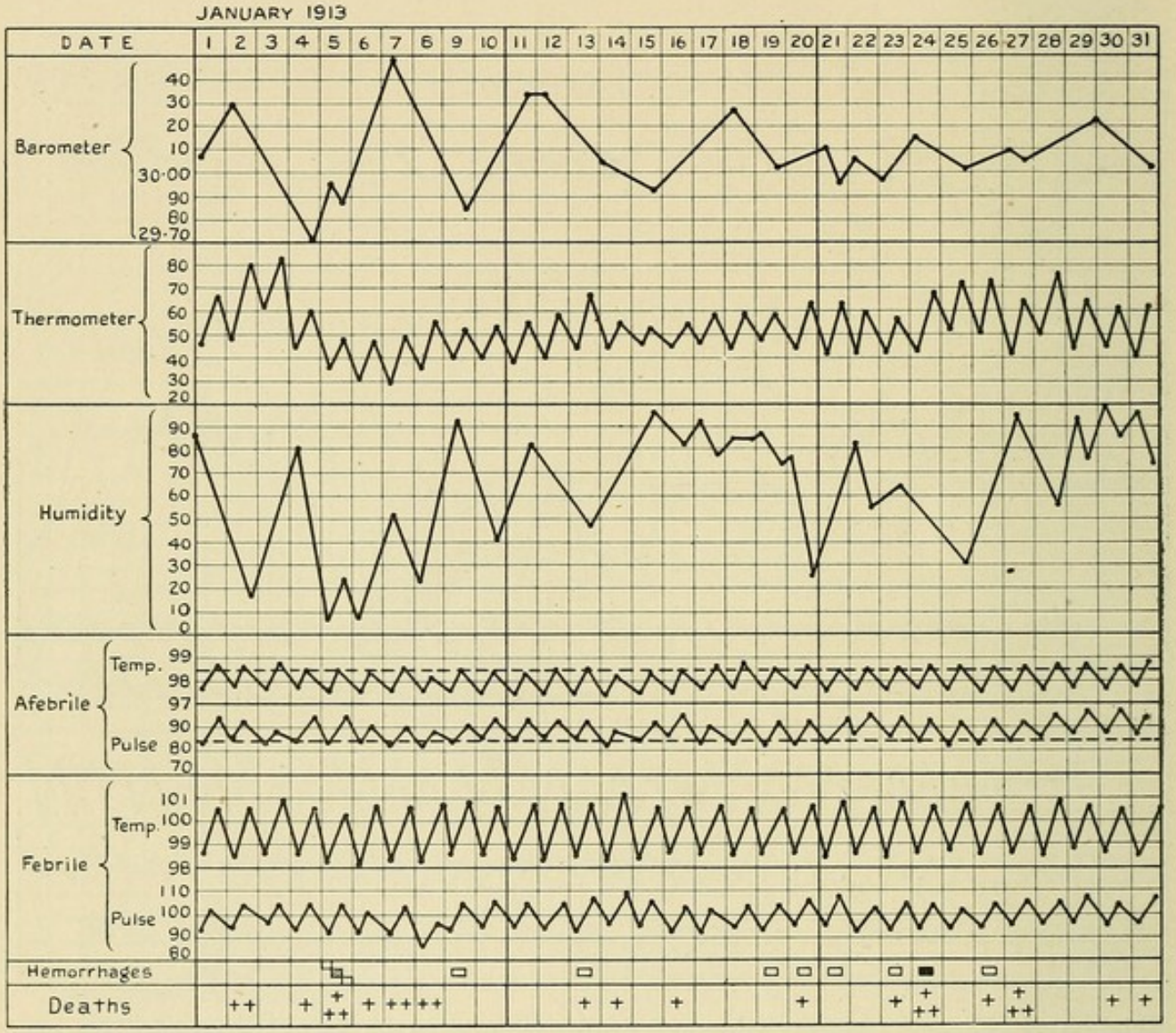
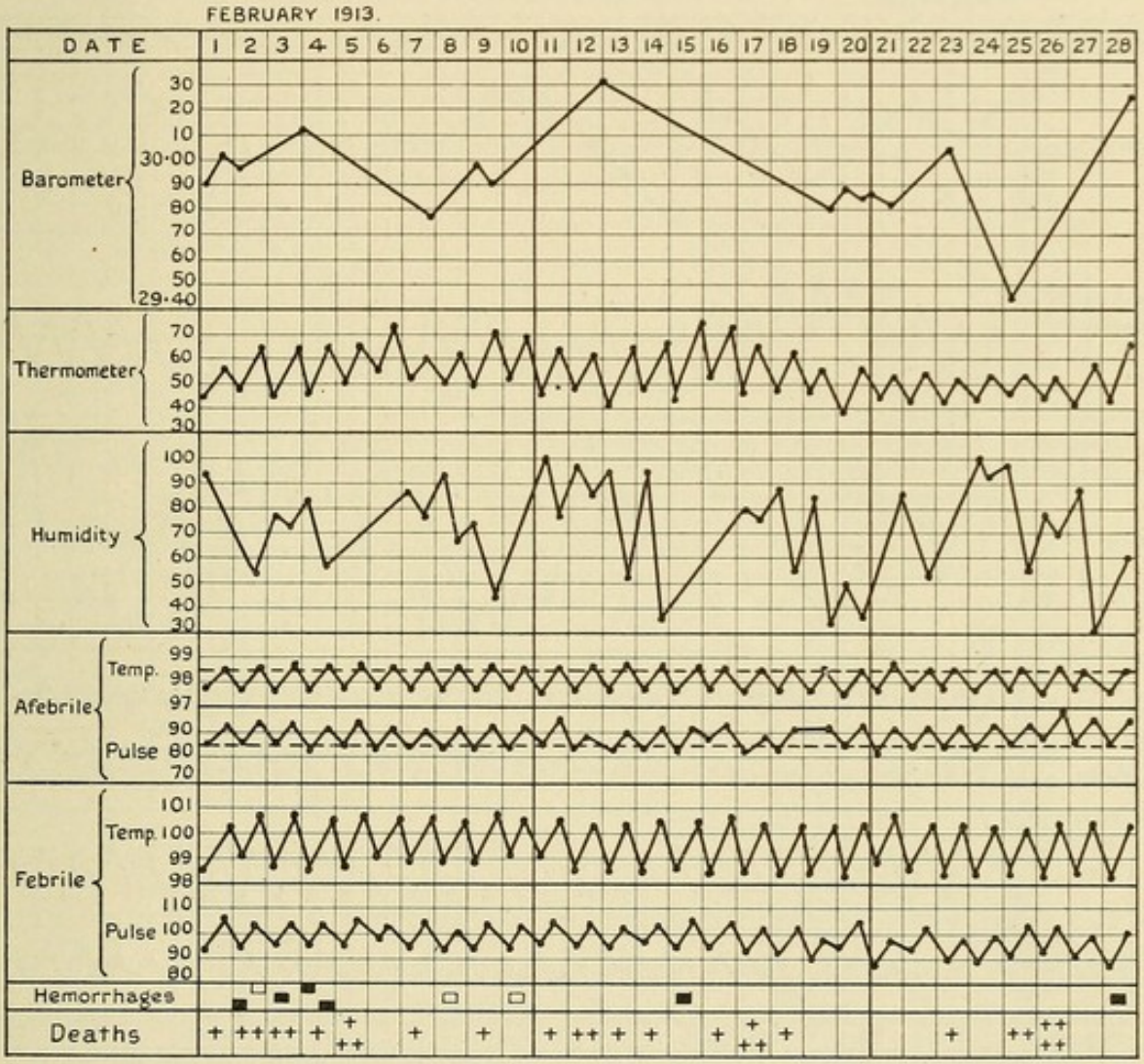
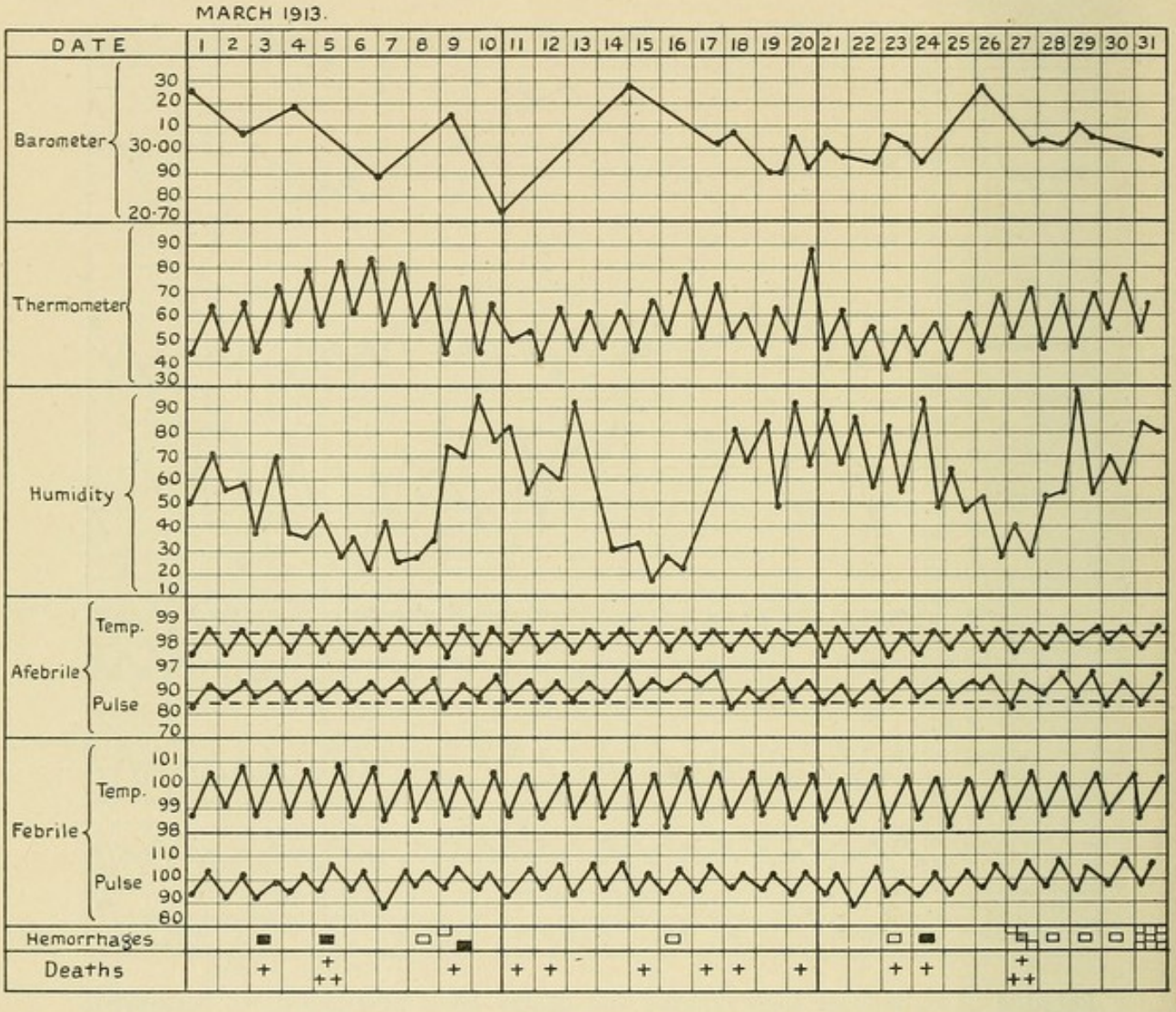


Relation of pulmonary hemorrhages and deaths from tuberculosis to barometric pressure, temperature and humidity. Courtesy of Dr. C. C. Browning, Los Angeles, Cal.



Relation of pulmonary hemorrhages and deaths from tuberculosis to barometric pressure, temperature and humidity. Courtesy of Dr. C. C. Browning, Los Angeles, Cal.



Relation of pulmonary hemorrhages and deaths from tuberculosis to barometric pressure, temperature and humidity. Courtesy of Dr. C. C. Browning, Los Angeles, Cal.

was a barometric pressure change exceeding .3 of an inch within twenty-four hours than when the change was less. The hemorrhages appeared to be more frequent if there had been a change in the opposite direction—a sudden fall. The cases observed were all in the advanced stage. The conditions which appear to influence groups of hemorrhages and deaths are barometric pressure, humidity and cloudiness, each in turn appearing to be the most prominent

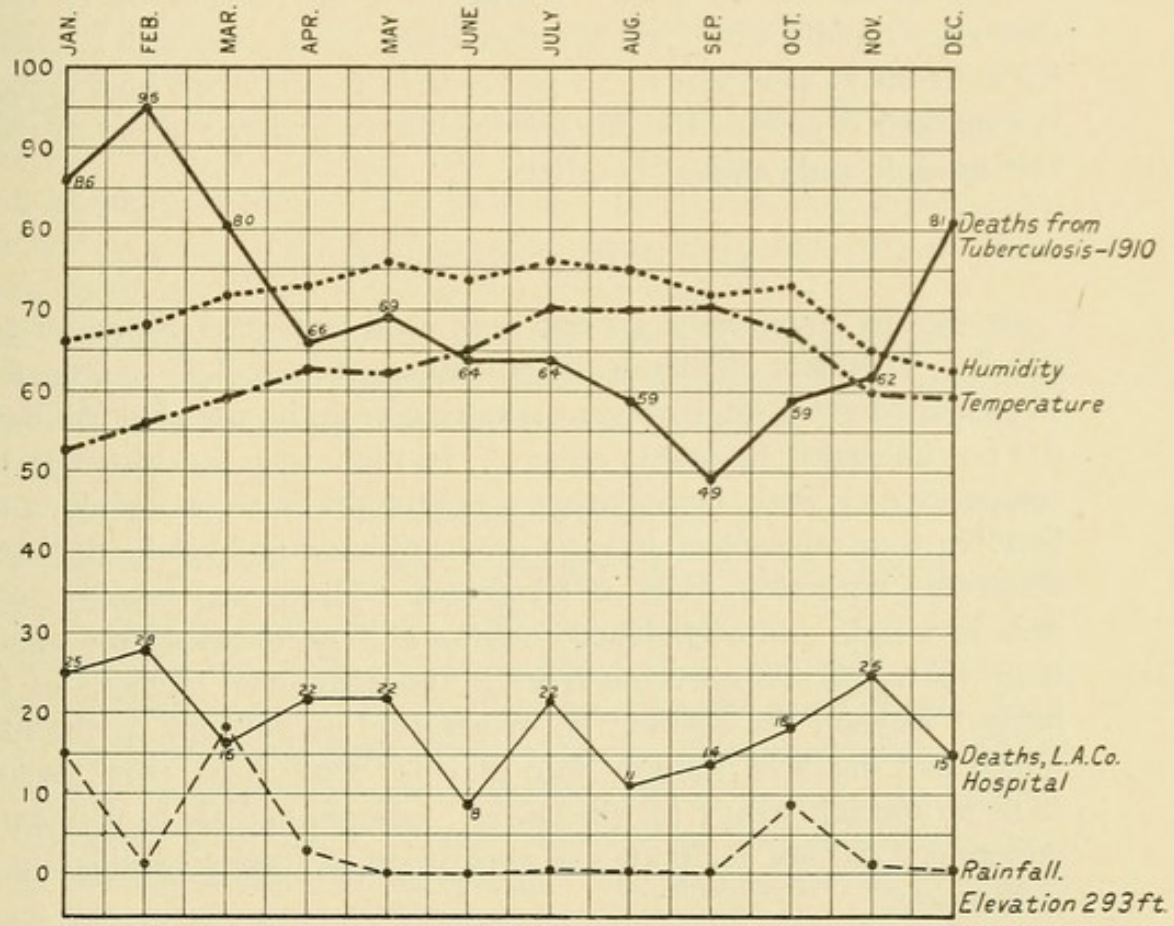


Chart showing deaths from tuberculosis in the Los Angeles County Hospital and in the city of Los Angeles in 1910. Rainfall, mean monthly temperature and relative humidity are also shown. Courtesy of Dr. C. C. Browning.

index in exerting a limited determining influence. This is shown in the two charts for November and December, 1912. Dr. Browning's paper contains charts for six other months.

Dr. Browning notes the influence of fog and remarks that the "high fog" is regarded by many as one of the most desirable factors of the Southern California climatic condition. It is not fog in the generally accepted meaning, for this "light veil" is neither cold nor excessively moisture laden; neither is it high, for its altitude is less than a thousand feet.

When the barometer is gradually rising and the humidity slowly falling and the sky clear or clearing, patients are pleasant, in some cases jovial and inclined to be optimistic as to the future.

When the barometer is either gradually or rapidly falling and the humidity rising and becoming more oppressive as the hours go by, and the day is foggy with little or no sunshine, the effect on patients is entirely different. They become pessimistic, cross and very irritable. During the so-called "northers," when the barometer falls, then rises rapidly with clear weather and a quick drop in the humidity as from 75 per cent to 20 per cent in twenty-four hours, there is a marked drying of the mucous membrane, causing great discomfort in some and comfort in others.

ARTIFICIALLY COMPRESSED AIR

Artificially compressed air has been used by Oertel, Simonoff and Charles Theodore Williams in pulmonary tuberculosis. The first two claimed great improvement resulting from its use; but Williams did not find such favorable effects.[1] In nine cases submitted to the compressed air bath, hemorrhage was brought on in two while in the bath; in four others hemorrhage occurred but could not be distinctly connected with this form of treatment. There was usually some gain in weight and diminished cough and expectoration, and apparently the respiration became freer in the unaffected portions of the lungs. Beyond the opening up or aeration of portions of the lung which had not been brought into play for some time, there seemed to be no special change for the better. Compressed air in Williams's experience did not facilitate the absorption of lung consolidation or infiltration.

At the Brompton Hospital a large wrought iron chamber was constructed about ten feet in diameter by eight feet in height, and accommodated four patients. It had thick glass windows and a closely fitting door. By means of inlet and outlet pipes compressed air was introduced and allowed to escape. The outer air from a pure source was filtered through cotton and pumped into the receiver. The pressure was gradually increased after the patients were inside the tank until it reached ten pounds or two-thirds of an atmosphere above the normal. Half an hour was spent in increasing the pressure, one hour in maintaining it at the highest point required, and half an hour in

[1] Charles Theodore Williams: Compressed Air Bath and Its Uses in the Treatment of Disease, London; Smith, Elder & Co., 1885, and Aerotherapeutics, Macmillan, London, 1894, p. 106.

reducing it; so that two hours were consumed in its application therapeutically.

A practical difficulty was encountered in keeping the compressed air sufficiently cool to be comfortable, owing to the fact that air invariably rises in temperature during compression and cools during rarefaction; so that in warm days ice had to be used about the reservoir.

Von Vivenot, in a careful series of experiments, showed that the influence of compressed air on the respiratory capacity was to permanently raise it. When used for two hours every day it is found to increase daily from 20 ccm. to 30 ccm. above the previous day's record. Von Vivenot took 122 compressed air baths during 143 days and his respiratory capacity was raised from 3051 ccm. to 3794 ccm. and, in compressed air, to 3981 ccm. This increased capacity was reached in three and a half months, after 91 baths and was afterward maintained at practically the same level.[1]

An increase in respiratory capacity has been noted by other observers, but the respiration rate is always lowered and in almost all cases there is a similar lowering of the pulse rate.

PNEUMATIC CABINET

These experimental results naturally appealed to phthisiologists and patients were treated at Brompton, as we have mentioned, and in the United States by means of Ketchum's pneumatic cabinet or similar devices. There is no doubt but that the method was given a fair trial, but it has been found wanting. The pneumatic cabinets installed at considerable expense at the Loomis Sanitarium at Liberty, at the Rush Hospital in Philadelphia and at Saranac, are rusting away or consigned to the scrap heap. The simpler and more natural method of outdoor life is found much more safe, rational and effective.[2]

See J. Solis Cohen: The Use of Compressed and Rarefied Air as a Substitute for Change of Climate in the Treatment of Pulmonary Phthisis. (Trans. Amer. Climat. Ass., Vol. 1, 1885).

V. Y. Bowditch: Ten Months Experience with Pneumatic Differentiation, *ibid.*, 1886, 47.

A. S. Houghton, Journ. Amer. Med. Ass., Nov. 7, 1885.

C. E. Quimby, Trans. Amer. Climat. Ass., Vol. 9, p. 33.

Isaac Hull Platt, Trans. Amer. Climat. Ass., Vol. 3, p. 76.

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[1] Paul Bert, *op. cit.*, p. 439.

Huggard, W. R.: Handbook of Climatic Treatment, p. 109.

[2] At Sharon Sanatorium it is still used in some cases as a means of calisthenics for the chest and is thought to be of value.

Tiegel, New Yorker Medicinische Presse, April, 1887.
E. L. Trudeau, Trans. Amer. Climat. Ass., 1886, p. 41.
Ketchum: Physics of Pneumatic Differentiation (Medical Record, Jan. 9, 1886).
Waldenburg, Pneumatische Behandlung, Berlin.
J. T. Whittaker, Gaillard's Med. Journ., August 1885, p. 208.
Herbert F. Williams, Journ. Amer. Med. Ass., Aug. 14, 1885.
Herbert F. Williams, Trans. Amer. Climat. Ass., 1886, p. 17.
B. F. Westbrook, Trans. Amer. Climat. Ass., 1887, p. 102.

ARTIFICIAL HYPERÆMIA

We must here refer to an important advance in the treatment of surgical tuberculosis in which artificial changes in the atmospheric pressure play a prominent part. Prof. Bier, of Bonn, first used his famous method in treating tuberculosis of joints; he used the "Stauungsbinde." He also uses cupping glasses of various shapes so that they may be applied to various parts. The rarefaction of the air is accomplished by a rubber ball, or a pump, according to the size of the glass. After opening tuberculous lymphatic glands and tuberculous abscesses in connection with joints, the cupping glasses are applied and the claim is made that this process avoids mixed infections. Tampons and drains, also, are found to be unnecessary.

In treating a member, for instance the hand, Bier uses a glass cylinder provided with a cuff and a rubber band, so that the whole hand is hermetically sealed and by means of the pump the air is partially exhausted. By similar apparatus Prof. Bier, Dr. V. Schmieden, Dr. Willy Meyer, Ewart, and others all over the world have treated successfully cases of surgical tuberculosis so that the method has an established place in tuberculo-therapy.[1]

CHAPTER VI. ARTIFICIAL PRESSURE; BREATHING EXERCISES

Radical differences of opinion exist as to the use of artificial variations of pressure, or pneumatic differentiation, in pulmonary tuberculosis and also as to the larger question as to whether the diseased lung should be set at rest or invited to expand.

The respiration of artificially compressed or rarefied air for limited periods, such as half an hour or two hours, has been considered, but this form of pulmonary gymnastics has given way to

[1] August Bier: Hyperæmie als Heilmittel, 5th edition. Prof. Bier advises a long continued residence at the seashore in cases of surgical tuberculosis.

more natural methods of accomplishing the results aimed at. The judicious use of exercises has been advocated for centuries and this plan of treatment has passed through most interesting phases, long advocated, then condemned and later revived. Some of the recent advocates of exercise by graduated labor invoke the very latest knowledge of the pathology of tuberculosis in support of this method.

The bad effects of exercise on tuberculous patients at the well-known climatic stations have been widely commented on and numberless histories of patients going to their death when caution might have saved them are on record. Patients going from the lower elevations to altitudes of five and six thousand feet do not seem to realize at first how necessary are rest and thorough acclimatization for their safety during the earlier weeks or months of treatment. The higher stations are natural gymnasia where diseased lungs may be trained or overtrained; where accidents may happen to the inexperienced and rash, or even to the old time expert if he neglects to exercise proper judgment. No fall from the trapeze is more fatal in its effect than some mountain expedition or other adventure by the tuberculous patient. Dr. Solly was wont to say that nowhere is the invalid fool more quickly punished for his folly than in Colorado.

We are concerned, at present, with exercise as it relates to the breathing habit and the aeration of the diseased lung. Exercises and improved breathing habits can be carried out and acquired at the sea-level or at higher elevations. We believe that at the moderate or higher altitudes breathing exercises are more effective for good and tend more fully to develop the thoracic movements and capacity than at the lower levels (see page 62). Minor has recently reviewed this subject in a paper or the "Use and Abuse of Pulmonary Gymnastics in the Treatment of Tuberculosis" and holds that they are beneficial in properly selected cases. That such measures are abused by those who use them indiscriminately and unintelligently we all know.

ATMOSPHERIC COMPRESSION OF LUNG

Fifteen years ago Cornet came out strongly against exercises and others of experience take even more radical ground. The principle of rest has been carried to such an extreme that surgical measures, such as strapping the affected side to insure complete immobilization, have been adoped.[1] The most radical measure was the introduction

[1] Charles Denison, Trans. Amer. Climat. Ass., Vol. 21, 1905.

into the pleural cavity of nitrogen gas, or atmospheric air, so as to compress the lung and prevent as nearly as possible all motion. The credit for devising this operation and first performing it, belongs to Forlanini, but it was first practiced in America by Dr. John B. Murphy,[1] of Chicago, and has been repeatedly used by many others in Europe and America, including the late Dr. Henry P. Loomis,[2] Dr. Cleaveland Floyd and Dr. Samuel Robinson, of Boston, Dr. L. Brauer, Prof. T. Beneke, of Hamburg, Dr. H. L. Barnes and Dr. F. T. Fulton, of Rhode Island.

ARTIFICIAL PNEUMOTHORAX

Prof. Theodore Beneke, of Hamburg, says[3] that Forlanini conceived the idea of placing the affected lung at rest by artificial pneumothorax as early as 1882; he put it in practice in 1888; Brauer and Ad. Schmidt performed it in 1906. Murphy seems to have developed his operation without any knowledge of Forlanini's work. The operation has been performed in Germany, according to Beneke, by hundreds of physicians on several thousand patients. The operation is meeting with great favor in America.[4]

The clinical observation that the occurrence of pleuritic effusion in tuberculous cases was followed by an arrest of the symptoms of the primary disease if the effusion were left undisturbed; and, further, the unfavorable results which follow tapping in other cases, or when later adopted in cases of quiescent during the presence of the effusion led to this method of artificially producing immobility. Pleuritic effusion is intimately connected with pulmonary tuberculosis in a majority of cases and, if not purulent, should probably be left undisturbed.

Loomis followed Murphy's technique, using a special apparatus for the injection of pure nitrogen gas by means of which from fifty

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[1] John B. Murphy: The Surgery of the Lungs (Journ. Amer. Med. Ass., 1898). Also Surgical Clinics of Dr. John B. Murphy, December, 1913. W. B. Saunders Co., Phila.; also Interstate Medical Journ., March, 1914.

[2] Henry P. Loomis: Some Personal Observations on the Effects of Intrapleural Injections of Nitrogen Gas in Tuberculosis (Trans. Amer. Climat. Ass., 1900; Med. Record, Sept. 29, 1900).

This method was first proposed by Prof. Carlo Forlanini, of Pavia, Italy, at the International Medical Congress, Rome, 1894.

[3] Ueber den kunstlichen Pneumothorax, "Tuberculosis." Berlin, Nov., 1913.

[4] See article by Dunham and Rockhill, with discussion by C. L. Minor, Journ. Amer. Med. Ass., Sept. 13, 1913.

to two hundred cubic inches were introduced into the pleural cavity on the affected side[1]

The nitrogen gas introduced into the pleural cavity does not remain long without being absorbed, and in order to keep the lung immobilized for six months or more, repeated injections are required. When ordinary atmospheric air gains entrance to the pleural cavity it constitutes the condition known as pneumothorax, and if the pneumothorax becomes closed, the oxygen steadily diminishes and finally disappears, the carbon dioxide decreases and the last element to disappear is the nitrogen. This fact has been determined by chemical analysis by Dory, Bouveret, LeConte, Ewald (Loomis). The respirations are always increased after the injections and the pulse rate is lowered. A notable effect in Dr. Loomis' cases was the absolute control of pulmonary hemorrhage in cases where all other measures failed.

Dr. Loomis' experience in eighteen cases treated by injections of nitrogen gas was uniformly favorable, although not curative. Probably the fact that pulmonary hemorrhage is controlled is the chief value of the method, though gain in weight followed the adoption of this measure in all the cases.

SONG CURE

One method of pulmonary exercise lately advocated for tuberculous patients is by singing.[2] Singing invokes correct nasal breathing and a maintenance of the elasticity and proper expansion of the chest. The necessary breathing exercises promote an increased functional activity of all parts of the lungs, including the apices where tuberculosis usually first becomes evident. It is here that expansion is most limited and the prevalent opinion is that this comparative inactivity is a strong factor in the tendency of the disease.

The "song cure" may be suitable in some cases of pulmonary

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[1] For a good description of the latest apparatus and a discussion of the most approved methods see articles by Harry Lee Barnes and Frank Taylor Fulton, and by Samuel Robinson and Cleaveland Floyd, Transactions of the American Climatological Association, 1913, pp. 160-188, and 1911, pp. 289-383. A bibliography is given in Transactions, 1913, p. 170.

See also Trans. American Sanatorium Association, 8th spring meeting, p. 16. Discussion by H. D. Chadwick, W. A. Griffin, E. S. Bullock, G. W. Holden, J. J. Lloyd, Jr., L. Brown, J. Roddick Byers.

See also Samuel Robinson, "Practical Treatment," edited by Musser and Kelly, W. B. Saunders Co., Philadelphia, 1911, Vol. 3, p. 254.

[2] Drs. Leslie and Horsford, The Hospital, London, Jan. 25, 1908.

tuberculosis, but in laryngeal cases it would be counter-indicated. Its practice in pulmonary cases has not been adopted to any very great extent; but it would seem to have some advantages as it does not involve great muscular fatigue.

It is well known that public speakers with pulmonary tuberculosis cannot continue this practice with impunity. Their tendency to attempt to increase their weakening vocal powers by forcing the air outward has a bad influence on the lungs. Bad habits of speaking and lack of training are probably accountable for these bad results. Artistic breathing should be cultivated and all public speaking in crowded and badly ventilated halls should be avoided.[1] Knopf refers to cases of phthisis[2] which had even passed the incipient stage and were cured after following the occupation of street singer or speaker. He cites the case of an English lady who became an evangelist, addressing crowds of people every night in open air meetings and who was actually cured of her tuberculous disease after following this calling for a year.

Our own experience leads us to believe this to be an exceptional result. Having had some experience in treating members of the Salvation Army in various grades of the service, the impression gained was that tubercular disease was quite common among them and that their life of exposure, unhygienic quarters, insufficient food and excessive use of the voice rendered them an easy prey to consumption. The voice is almost always over-strained and hoarse and the open air life the members lead is accompanied by hardships which over-balance any favorable features in their nomadic existence.

Open air singing, properly employed, as in the German Army, is, no doubt, beneficial. This should be encouraged by all military authorities. It relieves the tedium of the march and invigorates the soldier. Barth, of Koslin, has made a thorough study of the effects of singing on the action of the lungs and heart, on diseases of the heart, on the pulmonary circulation, on the blood, the vocal apparatus, the upper air passages, the general health, the development of

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[1] George Hudson Makuen: Artistic Breathing (Philadelphia Medical Journal, Sept. 3, 1898).

[2] S. A. Knopf: Respiratory Exercises in the Prevention and Treatment of Pulmonary Diseases (Johns Hopkins Medical Bulletin, Sept. 1901).

See also John H. Pryor, Deep Breathing as a Therapeutic and Preventive Measure in Certain Diseases of the Lungs (Trans. Amer. Climat. Ass., Vol. 22, 1906, p. 251).

the chest, on metabolism and on the activity of the digestive organs, and has come to the conclusion that singing is one of the exercises most conducive to health. (Knopf.)

CHAPTER VII. FRESH AIR SCHOOLS FOR THE TUBERCULOUS; VENTILATION

Under the name of "Waldschule" these have recently been established in Germany. The first was opened at Charlottenburg, Berlin, August 1, 1904, and closed its first term October 29th of the same year with 120 scholars. The results of the first year were very encouraging, the average increase in the weight of the children was five pounds, and the Forest School has been regularly opened each year.

The credit of its establishment belongs to the "Vaterländischer Frauenverein" of Charlottenburg. This patriotic association of women selected children either suspected of tuberculosis or with the disease already established for the Forest School. In this way educational facilities are provided for children whose condition renders them unsuitable for the public schools and at the same time avoids the necessity of sending them to sanatoria where there is little or no provision for teaching.

At Charlottenburg they put up so-called "Doecker barracks" or transportable buildings of light construction. There was one school barrack, containing two class-rooms and one teachers' room. The second barrack was used for household purposes. There was also an open "liege-halle" towards the south where the children may remain during bad weather. A light frame structure contains wash rooms and a bath-room with tub and douche. Three schoolmasters and one schoolmistress give instruction. The children were distributed in six classes of about twenty each. This is smaller than in the public schools where there are from forty-five to sixty in a class. The sessions never lasted over two hours continuously.[1]

This school has now grown so as to accommodate 240 children.

A second school is located in M.-Gladbach in the Rheinprovinz. It was opened in 1906 for sixty children between eight and fourteen years of age.

A third one is in Muhlhausen, Reichslande, Elsass-Lothringen, Southwest Germany. It was opened in 1906 and the physician in charge is Dr. Bienstock.

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[1] For further particulars of this school, see article by Dr. J. Nietner, Tuberculosis, May, 1905.

A fourth is the Forest School in the Victoria Louise Children's Sanatorium at Hohenlychen. It was established August 1, 1903. Pastor Mickley is in charge. These are the pioneer schools and many others have since been established.

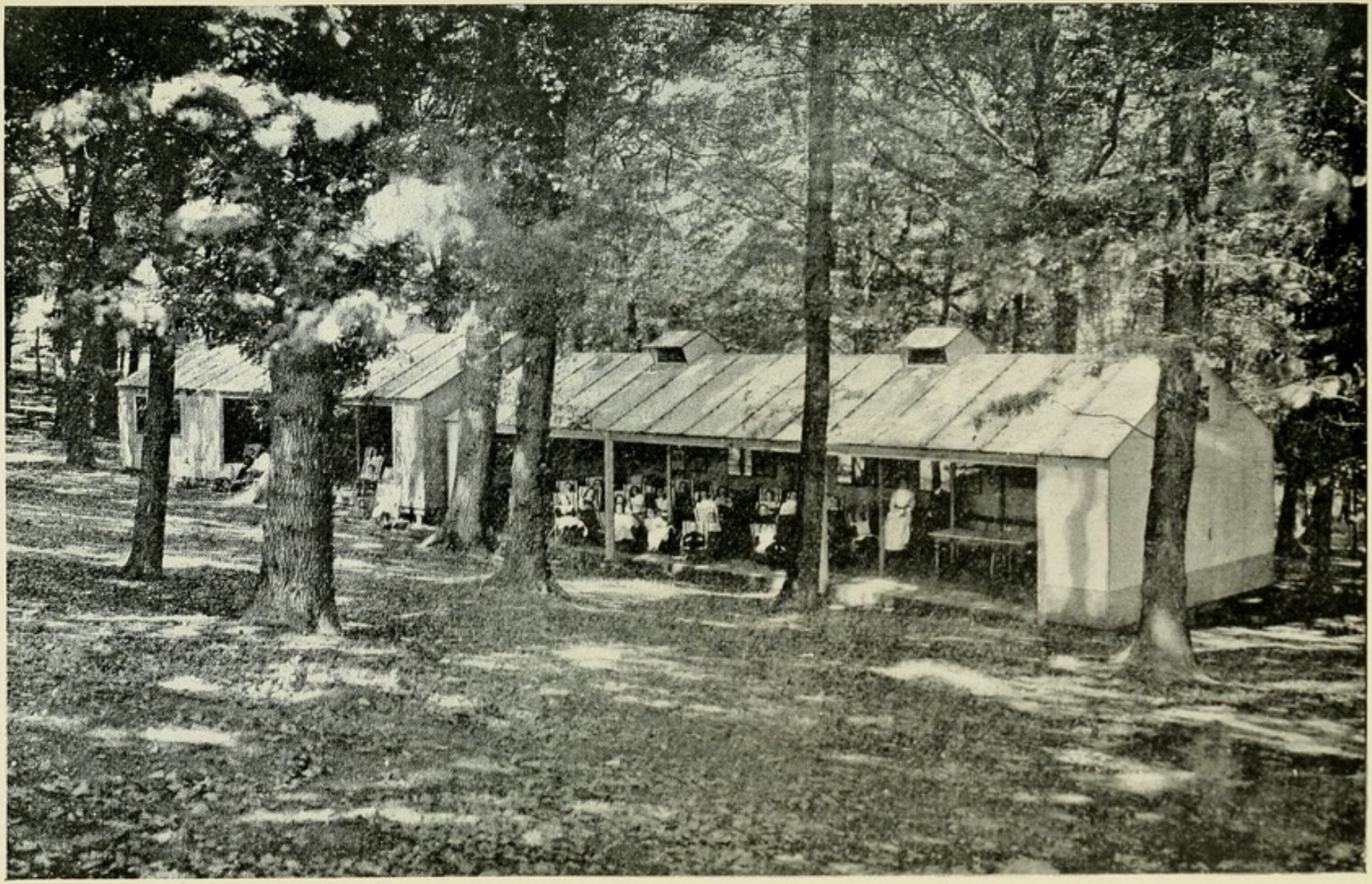
The most successful private open air schools in Germany are conducted by Prof. Dr. Gustav Pannwitz, the honorary secretary of the International Association for the Prevention of Tuberculosis. They are situated at Hohenlychen, about two hours by rail from Berlin, near Templin, on the hilly plateau which is called the " Mecklenburgisch—Pommersche—Seenplatte," between the East Sea and Spree Rivers. There are extensive forests of fir, a large lake with an island of 240 acres belonging to the school. It is conducted on the most modern hygienic principles.

An open air school was established at Bostall-Heath, near Woolwich, England, in 1907; in France, at Lyons, Vincennes and Boulogne; in Switzerland, at Lausanne, open from June 5 to September 23, at Zurich and Geneva. The " Rayon de Soleil " at Geneva, is for very young children; so also " Les Oisillons " at Lausanne.

In the United States the first fresh air school for tuberculous children was established in Providence, Rhode Island. Dr. Ellen A. Stone and Dr. Mary S. Packard had a small day camp during the summer of 1907 for children suspected of having tuberculosis. They soon became convinced that a fresh air school ought to be started for the benefit of the tuberculous children of Providence and they asked the help of Dr. Jay Perkins, Chairman of the Providence League for the Suppression of Tuberculosis in getting a single small school, necessarily ungraded, for those children, arranged so as to approximate an out of door school. At the camp which these physicians had been conducting there were about ten children who would soon have to go back to the ordinary schools or else would be at home in close rooms.

In response to this appeal Dr. Perkins enlisted the sympathy of the Superintendent of Schools, Mr. Walter H. Small, and with Judge Rueckert and Dr. Charles V. Chapin, the school committee established the first fresh air public school in America.

A school house not then in use and centrally located was requested for use and granted, and the necessary changes were made. The result was that they had to begin with a room on the second floor the full size of the building, about 40 by 25 feet, with windows on three sides. The brick wall on one-half of the southerly side was removed and windows substituted, these windows extending from near the floor to the ceiling, with hinges at the top and pulleys ar-



LONDON COUNTY COUNCIL'S OPEN AIR SCHOOL AT SHOOTER'S HILL. PAVILIONS
Courtesy of D. Walter Lindley

LONDON COUNTY COUNCIL'S OPEN AIR SCHOOL AT HORNIMAN PARK, LORDSHIP LANE. REST HOUR
Courtesy of D. Walter Lindley

ranged so that the lower end can be raised to the ceiling, thus leaving this half of the room completely open to the south. Each school desk and its accompanying seat is arranged on an individual wooden support so that, while stationary as regards each other, each desk and seat can be moved as desired, and thus any arrangement of seats may be made. The school is an ungraded one (the ages running from 7 to 13 years), and as such limited to 25 pupils. The school hours are from 9 to 11.45 a. m., and from 1.45 to 3.30 p. m., with a recess from 10.15 to 10.45. Towards the end of this recess each pupil is served a cup of hot soup. Each pupil has a sitting-out bag of the standard type and in very cold weather has a hot soapstone in the bottom of the bag. In the end of the room not open to the south a good fire is kept going, thus partially warming the air and keeping that end of the room moderately warm, the pupils' seats all being in the other end.

One interesting feature in connection with the school is that, though these children come from poor homes and there has been an extensive epidemic of "colds" in winter, especially affecting the nose and throat, no child in the school has had even a "cold in the head." On being enrolled, each child is weighed, measured, and the hemoglobin tested. The League furnishes the sitting-out bags and soapstones and some clothing, the city paying all other expenses.

Thus the credit for suggesting the school belongs to Drs. Packard and Stone, but the work was developed and carried on through the efforts of the League. Most of the children for the school are selected in the first instance by the head tuberculosis nurse and secondly by the physicians on the League Committee. All of them are from within walking distance of the school. Dr. Stone is one of the Medical Inspectors of the Public Schools and the other Medical Inspector, Dr. Charles E. Hawkes, was added to the committee.

Providence was the first city in the country to establish special schools for the mentally deficient and the school department is to be highly complimented because of the enthusiasm and energy with which they took up the establishment of a special school for the physically deficient as soon as the matter was presented to them.

This Fresh Air School in Providence was opened on January 27, 1908, with ten pupils, and soon twenty were enrolled. Hot soapstones, sitting-out bags, hot drinks at recess, frequent trips to the stove, breathing exercises, marching, bending movements, and uniform work in singing are prominent features of the pioneer fresh-air school in America.[1]

[1] Ellen A. Stone, M. D., Journal of the Outdoor Life, May, 1908.

The instruction of children at the Sea Breeze Hospital for Tuberculous Children at Coney Island is provided by the Board of Public Education of Brooklyn, New York, and the Board deserves credit for thus cooperating with the Sanatorium. Provision is now made in the larger cities for the regular and systematic education out of doors of tuberculous children in the community at large and the success of this movement is attested by the fact that on May 1, 1913, there were 177 open air schools in the United States, five of these are in Rhode Island; thirty in Manhattan; twenty in Brooklyn.

See also Jay Perkins, M. D.: Fresh Air Schools—How They Accomplish Their Result (Journal of the Outdoor Life, New York, June, 1912).

Les EColes de Plein Air, leur valeur prophylatique dans la Lutte Anti-Tuberculose, "Tuberculosis," Berlin, Nov., 1911.

The Open-Air School, Anna Garlin Spencer, Trans. Sixth International Congress, Washington, 1908, Vol. 2, p. 612.

Open Air Schools, Thomas Wray Grayson, M. D., Therapeutic Gazette, Nov., 1913, p. 27. Also John V. Van Pelt, Interstate Med. Journ., April, 1914.

In order to control tuberculosis effectively we shall have to make more determined efforts to reach the school children and even those of earlier years. Tuberculosis is latent in thousands of children in every large city; sooner or later it becomes manifest as vital resistance becomes lowered. A recent view, prevailing in France and Germany, is that all tuberculous infections are made in infancy and childhood, the disease lying latent, from one cause or another, until the individual resistance, weakened by successive colds, pneumonia, grippe or other infections, or exposure to reinfection, finally yields and tuberculosis is actively established. Both laboratory and clinical experience point to a much earlier primary infection than we have been accustomed to believe and hence too much stress cannot be laid on the importance of better ventilated schools and the establishment of more "fresh-air schools" in every city of the country. These should be located near parks, if possible, or at least have extensive play grounds.[1] They should be conducted also for the benefit of children who may be anemic, nervous, and not necessarily tuberculous; and also for apparently healthy children. The best example of the outdoor school for normal children has been opened at Bryn Mawr College, Pennsylvania, as the Phebe Anna Thorne Model School.

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[1] Henry Barton Jacobs, M. D., Journal of the Outdoor Life, April, 1908.

J. H. Lowman, M. D., Trans. Nat. Ass. for the Study and Prevention of Tuberculosis, 1907.

The three Elizabeth McCormick Schools, in Chicago, are admirable examples of the open air school.

FIG. 1. "RAYON DE SOLEIL," GENEVA, SWITZERLAND. DAY CAMP FOR ANEMIC AND DELICATE CHILDREN

FIG. 2. FOREST SCHOOL, GENEVA, SWITZERLAND

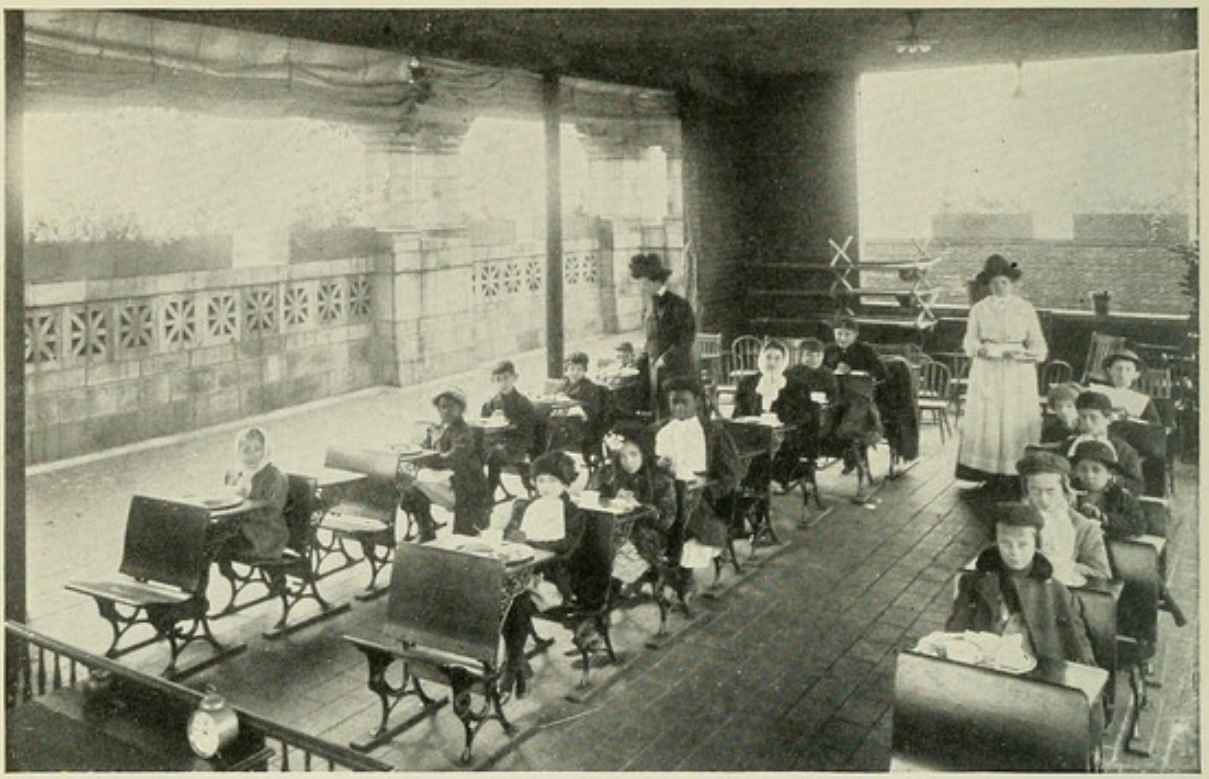
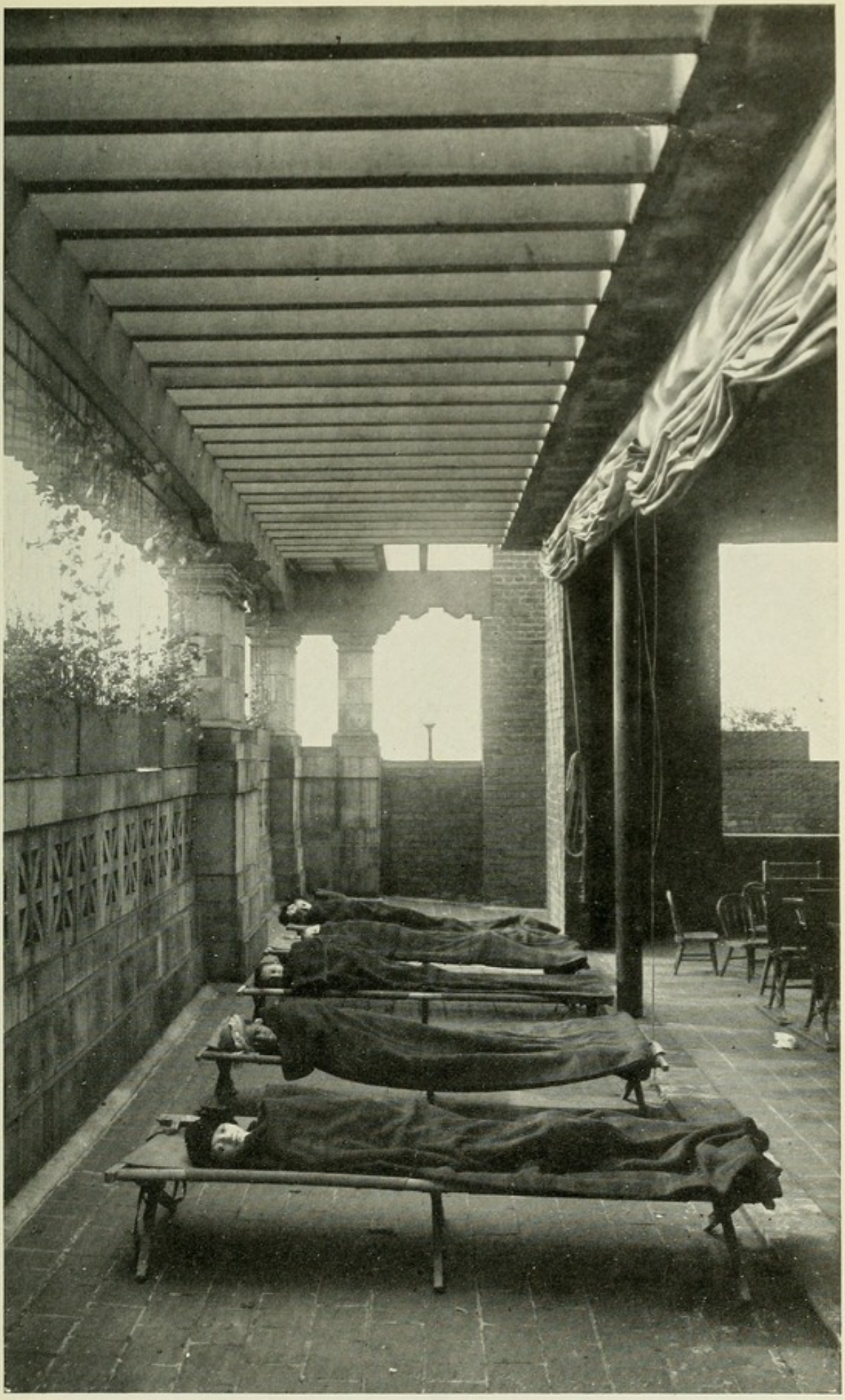


FIG. 1. OPEN AIR SCHOOL ESTABLISHED BY THE CIVIC CLUB, PITTSBURGH, PENNA. STUDY HOUR; WARM WEATHER

FIG. 2. OPEN AIR SCHOOL ESTABLISHED BY THE CIVIC CLUB, PITTSBURGH. STUDY HOUR; COLD WEATHER



OPEN AIR SCHOOL ESTABLISHED BY THE CIVIC CLUB, FITTSBURGH, PENNA. RESTING HOUR

OPEN AIR SCHOOL ESTABLISHED BY THE CIVIC CLUB, PITTSBURGH, PENNA. LUNCH HOUR

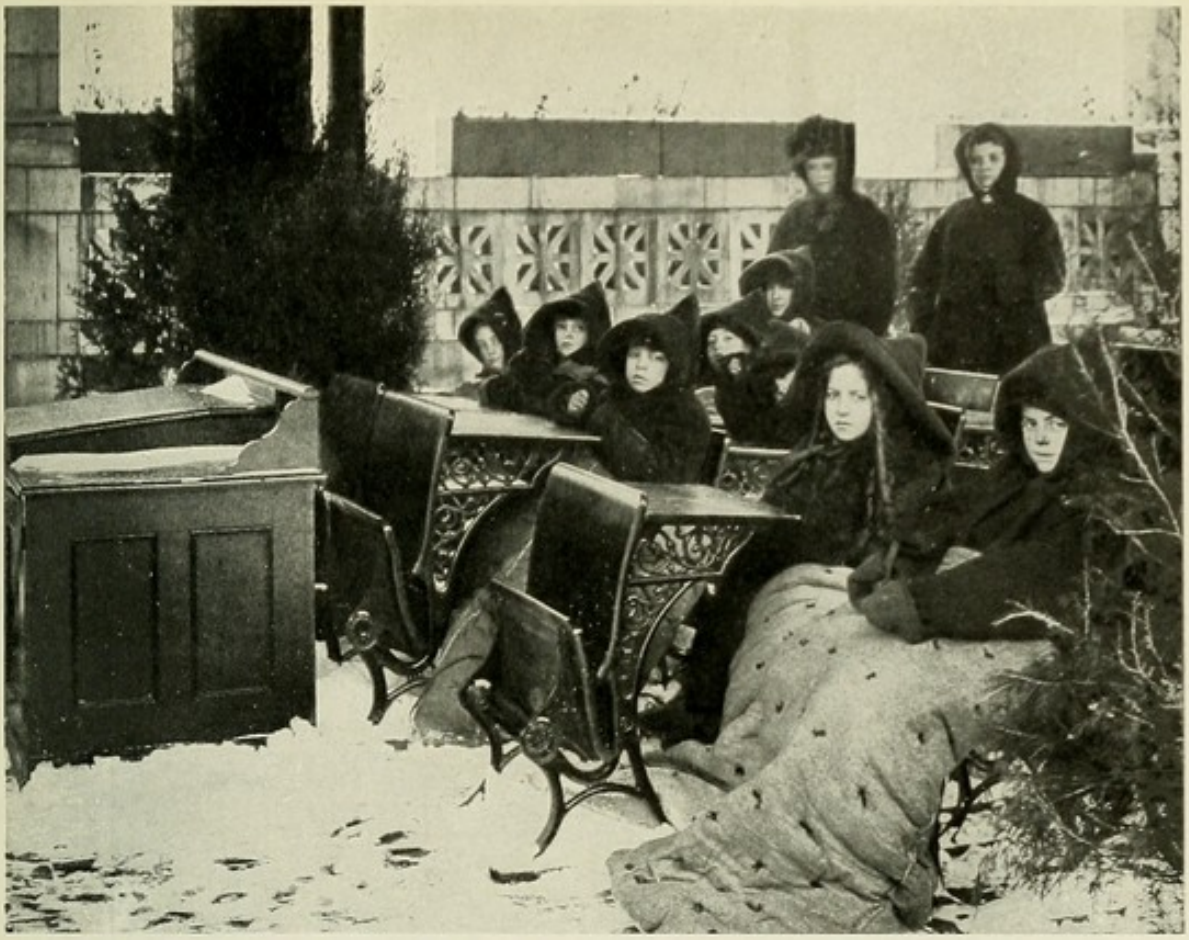


FIG. 1. FRESH AIR SCHOOL ESTABLISHED BY THE CIVIC CLUB, PITTSBURGH PENNA

FIG. 2. OPEN AIR CLASS FOR ANEMIC CHILDREN AT PUBLIC SCHOOL NO. 21, NEW YORK CITY
Courtesy of Dr. J. W. Brannan

OPEN AIR CLASS, ROYAL VICTORIA HOSPITAL, EDINBURGH, SCOTLAND
Courtesy of Sir Robert Philip

Other private schools are advertising open air classrooms, *e. g.*, the Horace Mann School, the Packer Institute of Brooklyn and the Brooklyn High School.

All measures to preserve the purity of air and its freedom from dust should be rigidly enforced in schools. Bad ventilation is the rule except in the most modern school buildings. After two hours the air is depressing and carbonic acid is usually found in excess. The problem of how to deal with dust is a difficult one in schools, owing to the expense of really efficient methods. The floors should not have open crevices and dry sweeping should not be allowed. Sweeping with wet saw dust is probably the most effective, and at the end of each term a thorough bacteriological dust disinfection should be carried out by the Department of Health. Dr. J. H. Lowman, of Cleveland, who has instituted great reforms in the hygiene of the schools of that city, recommends not formaldehyde, but that the walls should be cleaned or painted, the furniture washed and the floors treated with dilute solutions of chloride of lime.

We recognize tuberculosis to be one of the greatest dangers to school children, for at the tenth year the Prussian statistics show that out of 100 boys who die, 9.26 die of tuberculosis, and out of 100 girls, 12.02 die of tuberculosis; hence the importance of all hygienic safeguards against this malady.

Tracheo-bronchial tuberculosis and tuberculosis of the lymphatic system are the forms most commonly encountered and strict medical inspection will reveal large numbers of children for whom fresh air schools or sanatorium schools should be provided. In New York City, out of about one hundred thousand children examined in 1905-1906, over one thousand were found to have pulmonary disease, and in almost every case it was the first intimation to the mother that her child had pulmonary tuberculosis.

Besides the Waldschule of Germany there are specially constructed sanatorium schools in Milan, Italy, and vacation colonies have been established near Geneva, the Swiss Government supplying the teacher while philanthropy supports the schools. In Denmark, where the outing vacations are so thoroughly systematized, the teachers are supplied by the state. The United States show promise of carrying out this enlightened method of dealing with the tuberculous problem. Outdoor schools are conducted successfully in connection with private camps for boys and girls. Many of these are in New Hampshire and Maine, in the vicinity of the Rangeley Lakes, and in Oxford County.

IMPORTANCE OF VENTILATION

The first desideratum in tuberculo-therapy and in the prevention of tuberculosis is abundant and free ventilation. The dwelling, the bedroom, the workshop, the office, the church, the schoolroom, the theatre, the modern subway are one and all dangerous in proportion, as their atmosphere is composed of dead or rebreathed air. Not only is tuberculosis favored by unhygienic surroundings and vitiated atmosphere in particular, but no other agent, not excepting alcohol and bad food, so surely undermines the constitution and renders it unable to resist disease. Air that has once been breathed, ought not to be breathed again. Out of doors the danger is minimized; indoors we usually breathe and rebreathe the contained air again and again. To some extent, of course, this cannot be avoided, but we should endeavor to reduce it to a minimum. This subject has been recently investigated by Dr. Thomas R. Crowder, who studied by ingenious methods the effect of such factors as change of position, body motion, different types of breathing and different temperatures and, in addition, has determined the conditions that obtain on the sleeping porch and in the open air. Nasal breathing was the type examined, since in mouth breathing there is, under favorable circumstances, little reinspiration.[1]

The conclusions that may fairly be drawn from Crowder's work are that (1) a person remaining quiet and indoors will immediately rebreathe from 1 to 2 per cent of his own expired air; (2) when lying in bed the percentage is higher, rising to from 4 to 10 per cent, depending on the position assumed while sleeping. "Nor does sleeping in the open insure pure air for breathing. The same influences here produce the same relative results that they do inside. When one buries his head between pillow and bed clothes for the sake of warmth, reinspiration is inevitable, and it is not necessarily small in amount." In addition, it must be noted that at each inspiration we reinhale not only some of the air just exhaled, but also the air contained in the nose and larger bronchi—the so-called "dead-space" air. This may amount to one-third of the whole volume in quiet inspiration and not less than one-tenth in deep breathing.

The significance of this study in connection with questions of ventilation is obvious. Since even under the most favorable conditions we cannot avoid drawing back into the lungs some of the air that has just passed out of them, not much importance can be attached to the slight variations in carbon dioxide content which occur in the air of rooms.

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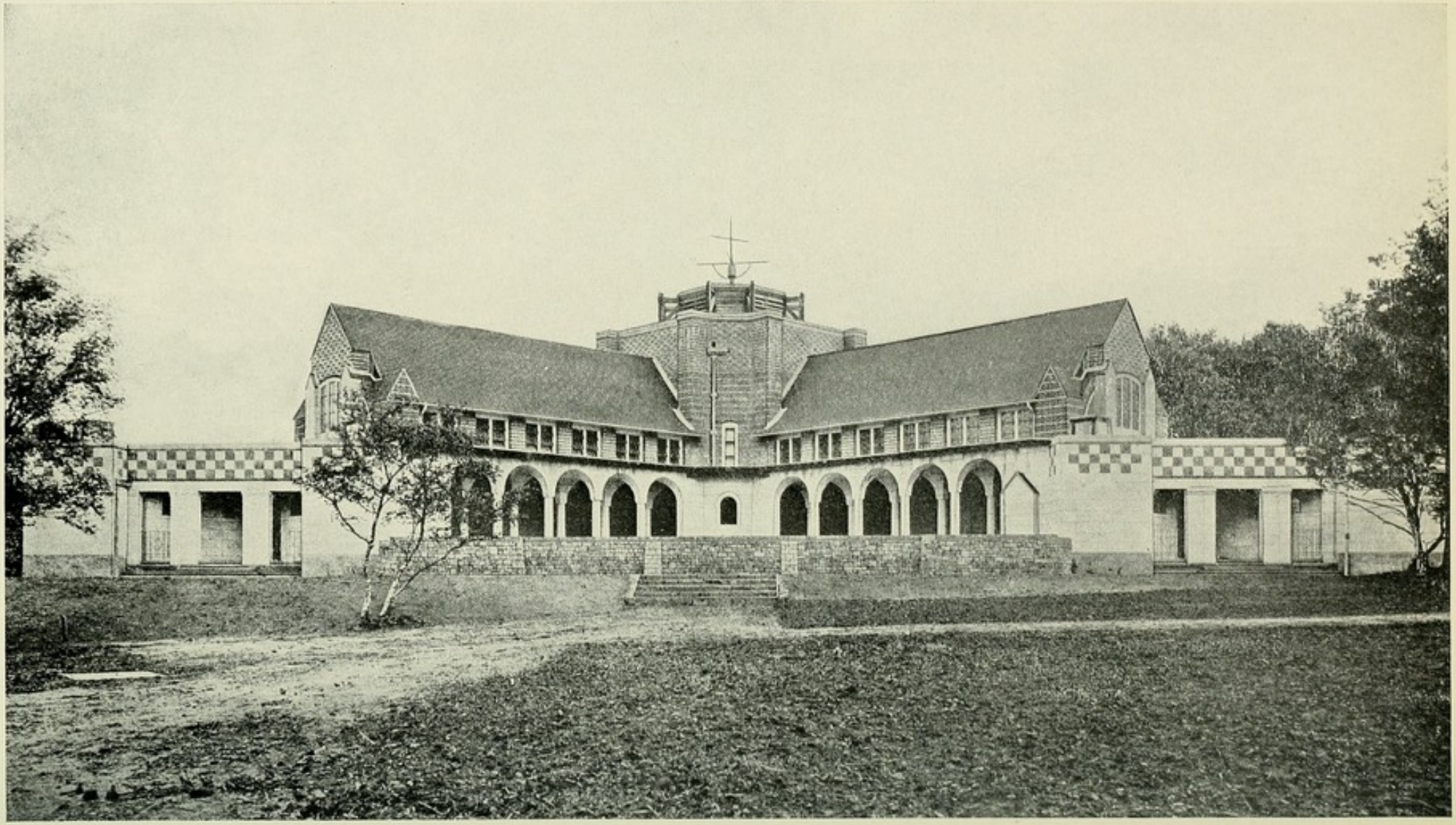
[1] The Reinspiration of Expired Air. Archives of Internal Medicine, Chicago, October, 1913, p. 1936. Journ. Amer. Med. Ass., Editorial, Nov. 29, 1913, p. 1986.

PORTABLE OPEN AIR SANATORIUM FOR CONSUMPTIVES ON THE GRABOWSEE, NEAR ORANIENBURG. DOECKER CONSTRUCTION
Courtesy of Christoph and Unmack



THE OPEN AIR CHAPEL, KING EDWARD VII SANATORIUM, MIDHURST, ENGLAND

OPEN AIR CHAPELS AND THEATRES

It is remarkable how inconsistent we all are in matters of hygiene. Medical men are often among the worst offenders. Their offices are commonly stuffy, their conventions and social gatherings are often held in inadequate halls in which vitiated air, sometimes reeking with smoke, is perfectly abominable.

> If to do were as easy as to know what 'twere well to do
> Then chapels had been churches and poor men's cottages princes' palaces.

We cannot go back to the time of the Druids or worship in groves after the manner of the Greeks, but it seems fitting here to call attention to one chapel that has been specially constructed for out-of-door worship and that is destined to be a model for many a sanatorium at least. This has been constructed for the famous King Edward VII Sanatorium near Midhurst, in Sussex, England. The accompanying illustration of this unique chapel marks a step in advance in sanatorium construction. It is in the Moorish style, shaped like a broad letter V. The double rows of columns of the cloister are on the southerly side, the pulpit and chancel are in the apex and the northerly sides forming the inner walls are provided with arched apertures so that the patients may sit absolutely in the open air but with sufficient protection from the weather at all seasons. In fair weather services are held under the sky in the open space in front of the building between its extended arms. The illustration shows this very beautifully.

Open air theatres were built by the Greeks and Romans and the remains of these structures are among the most interesting of ancient ruins. In Europe the Passion Play at Bayreuth is enacted wholly out of doors, but is entirely apart from our subject except so far as it demonstrates the possibilities of out-of-door representation. The low theatre and concert hall are invariably hot and stuffy and undoubtedly foster tuberculosis by inadequate ventilation. It would be better if we could have some theatres or assembly halls with perfectly free circulation of air.

The Groton School in Massachusetts has lately undertaken to build an outdoor gymnasium, so that the boys shall have the advantage of the open air rather than in an enclosed building. This is the first school we know of to adopt this admirable plan.

VENTILATION OF DWELLINGS

Ordinary dwellings are terribly deficient as regards ventilation. The country dwellings of the poor are strangely defective in this

respect. It has been said that the reason why the air in rural districts is so pure is that the poor country people have all the bad air shut up in their houses. There is a great deal of truth in this. Doctors are constantly struggling with the strange aversion that the rural population has regarding sufficient air in the bedrooms. As soon as night falls the windows and doors are tightly closed and the kerosene lamp adds to the pollution of the air. It is a common experience to find the doors and windows kept closely shut owing to the deeply rooted fear of catching cold. In European countries the windows of many of the older dwellings were originally intended for light and not for air, and are merely panes of glass built into the wall and not intended to be opened. Others are so badly constructed that the upper sash cannot be lowered and the lower sash is scarcely ever raised more than a few inches.

The children in many country cottages instead of being rosy and robust, as they should be with healthy surroundings, are frequently pale and bloodless on account of this bad air. This deficient ventilation of country houses and the bad food so common, where milk and eggs ought to be so plentiful and good, conspire to give to some country populations a bad start in the earlier years. No better example can be cited than that of the "poor whites" of the Southern United States. Indolence, ignorance, general helplessness and inertia are their characteristics. Their children are pale and gaunt, and their living quarters are horrible beyond description. It is a wonder the death rate among them is not greater than it is.[1]

It seems very strange, but it is a fact, that about seventy years ago a proposition was made to use the Mammoth Cave in Kentucky as a winter resort for invalids. Sixteen consumptives were sent there to gain the reputed benefit from the equable temperature and asserted purity of the air in that cavern. Five of these patients died and the others were injured as a result of the darkness and dampness combined. That such an irrational and cruel experiment should have been tried seems incomprehensible at the present day.[2]

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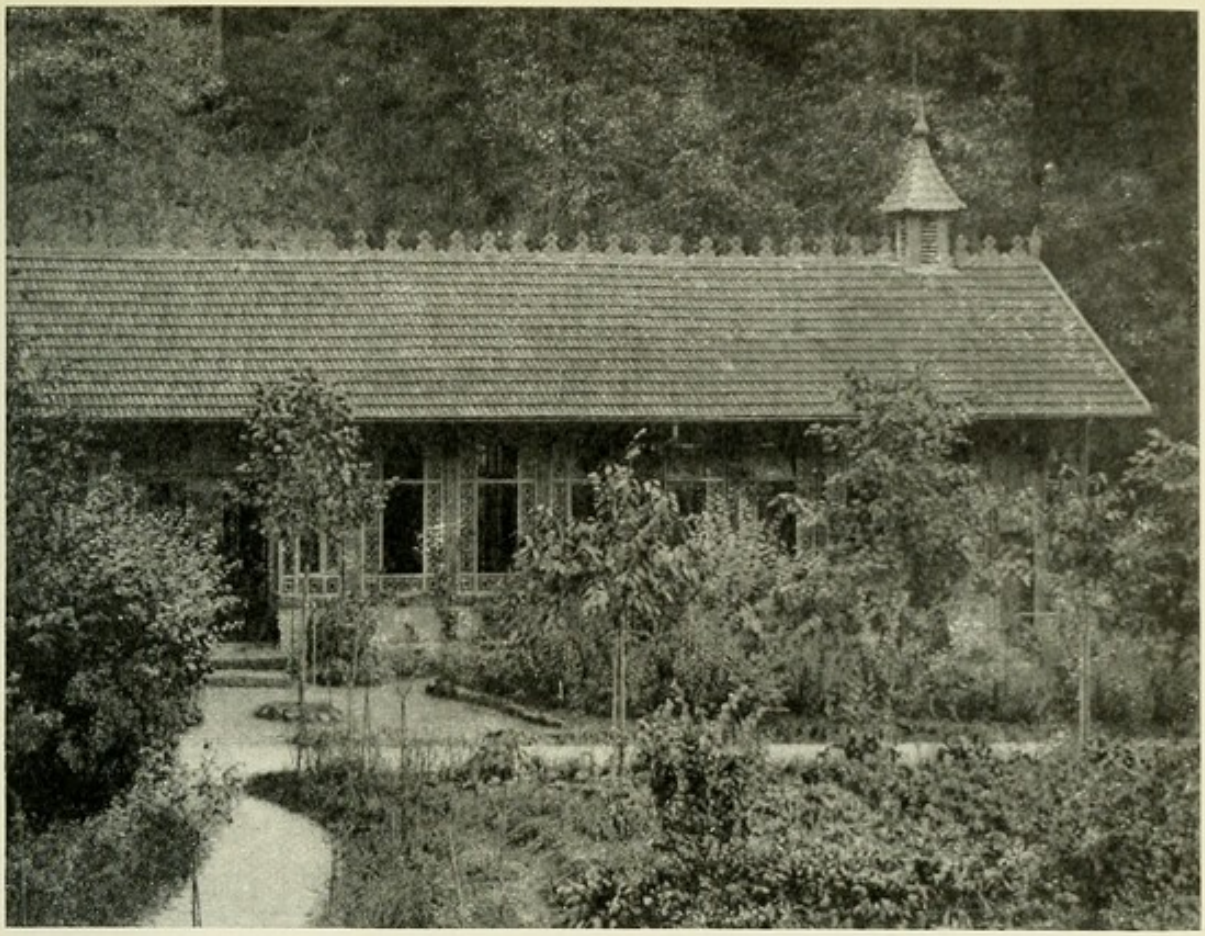
[1] The death rate from pulmonary tuberculosis for Virginia during the year ending June 30, 1913, was for whites 98.4, and for colored 256 per 100,000. The state rate was estimated at 148.

[2] See Croghan: The Mammoth Cave as a Winter Resort for Invalids (Boston Medical and Surgical Journal, 1843, Vol. 28, p. 188).

Daniel Drake, M. D.: Western Journal of Medicine and Surgery, Louisville, Kentucky, 1843, Vol. 7, p. 78.



OPEN AIR DINING HALL. DR. WALTHER'S SANATORIUM, NORDRACH-COLONIE, BLACK FOREST, GERMANY

LAWN CUTTING. GRADUATED LABOR IN PULMONARY TUBERCULOSIS. SANATORIUM OF THE BROMPTON HOSPITAL, FRIMLEY, ENGLAND

ROYAL VICTORIA HOSPITAL FARM COLONY. PLANTING POTATOES. GRADUATED LABOR
Courtesy of Sir Robert Philip

CHAPTER VIII. EXERCISE IN TUBERCULOSIS; GRADUATED LABOR

The Nordrach system of treatment of pulmonary tuberculosis carried out by Dr. Walther and that of his predecessor, Dr. Brehmer, at Goebersdorf, in Silesia, involves much exercise in addition to fresh air and alimentation; the Dettweiler system enjoins rest in the open air with superalimentation. McLean's dictum is: "If the phthisical patient would live, he must work for it."[1] Probably this advice should not be taken too literally, at least by every tuberculous patient; but graduated physical exercise has a very important and useful place in the treatment of most patients. Brehmer advocated hill-climbing, while Walther advises graduated walking exercises, in some cases to the extent of walking twenty miles a day. Whether one practices walking, or hill-climbing or graduated labor, we cannot dissociate from these measures the effect of atmospheric air, in its various qualities, upon the lungs and the accompanying stimulation of the pulmonary and general circulation. Two recent papers by London practitioners are full of such suggestive thoughts on this subject that we call special attention to them. They are considered by some as marking an epoch in the treatment of pulmonary tuberculosis.

At a meeting of the Medical Society of London, January 13, 1908, Dr. Marcus S. Paterson, the Medical Superintendent of the Brompton Hospital Sanatorium, at Frimley, read a paper on "Graduated Labor in Pulmonary Tuberculosis" which was supplemented by another on the "Effect of Exercise on the Opsonic Index of Patients Suffering from Pulmonary Tuberculosis," by Dr. A. C. Inman, Superintendent of the Laboratories, Brompton Hospital.[2]

The patients for whom Paterson instituted graduated labor were selected cases sent from the Brompton Hospital in London to its Sanatorium at Frimley, at an elevation of 380 feet in the country.

He was induced to carry out this plan of treatment after seeing tuberculous patients who did well while working under unfavorable surroundings; but he believed that under careful regulation of labor and with very careful observation of the temperature records, he might safely proceed. The exercises adopted involved all the muscles of the trunk and extremities and this was thought to be better than walking exercises in which the lower limbs were chiefly employed. The use of the upper limbs seemed more likely to favor

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[1] McLean: Personal Observation in Phthisis Pulmonalis (Journal Amer. Med. Ass., February, 1898).

[2] The Lancet, January 25, 1908.

the expansion of the lungs. It was not forgotten that the common objections to this plan of treatment are, (1) that the disease would become active again under the strain; and (2) that the exertion would tend to produce hemoptysis. Considerable tact and personal influence must have been exerted to get the patients to carry out a plan which involved increasing labor and measures that are generally considered positively harmful.

The first exercise ordered was walking, the distance being gradually increased up to ten miles a day. When a patient had reached this stage he was given a basket in which to carry mould for spreading on the lawns. No case of hemoptysis or of pyrexia occurred among these patients. When they had been on this grade with nothing but beneficial results for from three weeks to a month, they were given boys' spades with which to dig for five minutes followed by an interval of five minutes for a rest. After a few weeks, several of the patients on this work, who were doing well, were allowed to work as hard as possible with their small spades without any intervals for rest. As they had all improved on this labor larger shovels were obtained, and it was found that the patients were able to use them without the occurrence of hemoptysis or a rise of temperature. About this time many of the patients were feeling so well that it became necessary to restrain them from doing too much.

These results in a few cases creates a most favorable sentiment among the other patients so that the system was extended generally, with great care and minute supervision. Harder work was prescribed for patients who could be trusted even to the use of spades, shovels and five pound pick-axes. The patients all expressed the opinion that the work did them good and that the harder they worked the better they felt. Many patients have written to Dr. Paterson to say that they date their improvement from the commencement of the labor, and that they think the hardest work did them the most good. It certainly speaks well for the strict supervision of these patients that no accidents occurred of a serious nature, though several developed fever and, subsequently, pleurisy. One patient was laid up for two months and was much worse at the end of that time, though eventually he did well and returned to work, though the extent of his disease was increased through overexertion.

The suitability of cases for graduated labor rests on a very careful physical examination, importance being laid on the general muscular and physical development. Marked wasting and poor development is, naturally, a bar to this method of treatment. The resisting power

ROYAL VICTORIA HOSPITAL FOR CONSUMPTION, EDINBURGH. GRADUATED LABOR; ROAD MAKING BY THE PATIENTS ON HEAVY GRADE WORK. THERAPEUTIC AUTO-INOCULATION ARTIFICIALLY CONTROLLED BY MANUAL LABOR

Courtesy of Sir Robert Philip

THERAPEUTIC AUTO-INOCULATION ARTIFICIALLY CONTROLLED BY MANUAL LABOR. LOOMIS SANATORIUM, NEW YORK.
LIGHT GRADE WORK IN THE GARDENS

of a patient with a very limited lesion is an unknown quantity and has to be determined, whereas a patient with a lesion involving four lobes may remain at work for some time and exhibit a good initial resisting power.

Dr. Paterson lays very great stress on the temperature taken in the mouth. If this is or has been 99° F. or over during the week preceding admission to the sanatorium, the patient is put to bed after the journey. So long as the temperature remains at 99° F. in the case of men or 99.6° F. in the case of women, the patient is not allowed up for any purpose. So long as the temperature is unaffected by exertion the patient is gradually allowed up for longer and longer periods. Patients with apparently limited disease, but who are in poor general condition and without fever, are allowed to be up all day, but are not permitted to take further exercise than is entailed by walking to and from the dining hall for their meals. The remainder of the day is spent in resting. As their condition improves they are allowed to walk half a mile a day, and so on, until a distance of six miles a day is reached. The rate of increase in the amount of exercise depends upon such factors as the patient's disposition, weight and appetite.

The grades of work are briefly as follows:

(A 1) Walking from one-half to ten miles daily.
(1) Carrying baskets of mould or other material.
(2) Using a small shovel.
(3) Using a large shovel.
(4) Using a five-pound pick-axe.
(5) Using a pick-axe for six hours a day.

Patients in grades 1, 2, 3, and 4, work four hours a day.

The basket work in which about eight pounds of earth are carried is considered the most important and, as a rule, patients spend far more time in this work than in any other. It brings into use all the muscles.

Work has a wholesome effect on the mind. If the patient is at first sullen and apathetic, the improvement in physical condition quickly begets a lively and cheerful mental attitude, and one that seeks work rather than to shirk it.

During 1905 and 1906 the number of patients discharged from this sanatorium was 164, and they all returned to their previous occupations, whatever they happened to be, and not to light, outdoor work. They were fitted by the line of treatment which we have described for effective wage earning.

We have dwelt quite fully on this innovation in tuberculo-therapy because it gives promise of good, practical results and, further, because it is so radically different from the prevailing methods adopted in most sanatoria. But, the most interesting feature is the explanation which is offered to account for the benefits which has accrued. This explanation is set forth in an elaborate study made by A. C. Inman, M. B., the superintendent of the laboratories of the Brompton Hospital, on the "Effect of Exercise on the Opsonic Index of Patients Suffering from Pulmonary Tuberculosis."[1]

This study of Inman's was prompted and made possible by the brilliant work of Sir Almroth Wright. Wright showed in his Harveian Lecture in New York, that there are three great agencies by which immunizing responses can be evoked in the organism:

(1) By the inoculation of bacterial vaccines.

(2) By artificially induced auto-inoculations.

(3) By spontaneous auto-inoculations.

Wright had previously elucidated the subject of vaccine therapy by constructing curves from the opsonic indices of patients vaccinated against their infection and in this manner traced a definite train of events which follow upon a single inoculation. The successive phases were termed the negative phase, the positive phase and the phase of maintained high level. Freeman, working in Wright's laboratory, then took up the subject of massage in its effect on gonococcal joints showing that "*Auto-inoculations follow upon all active and passive movements which affect a focus of infection and upon all vascular changes which activate the lymph-stream in such a focus.*"

Wright's dictum was that "where in association with a bacterial invasion of the organism bacteria or bacterial products pass into the general lymph, and blood-stream, intoxication effects and immunizing responses, similar to those which follow upon the inoculation of bacterial vaccines, must inevitably supervene." It is a perfectly logical conclusion, then, that nature cures bacterial infections through such auto-inoculations. Inman set himself to find out what the body is doing of itself and what value extraneous circumstances, such as physical exercise, have in aiding these attempts on the part of the body. Inman's work was conducted on a carefully planned technique, controlled and checked at all points, using forty-three patients in the sanatorium treated by the System of Graduated Labor.

Inman found that in 41 out of 43 cases the opsonic index was at

[1] Read before the Medical Society of London, January 13, 1908.

THERAPEUTIC AUTO-INOCULATION ARTIFICIALLY CONTROLLED BY MANUAL LABOR. LOOMIS SANATORIUM, NEW YORK.
HEAVY GRADE WORK; ROAD MAKING

THERAPEUTIC AUTO-INOCULATION ARTIFICIALLY CONTROLLED BY MANUAL LABOR. LOOMIS SANATORIUM, NEW YORK.
HEAVY GRADE WORK; ROAD MAKING

some time of the day well above the normal, and what is of even more importance, in no case did the exercise, even though severe, lower the index below the normal line—that is, the auto-inoculation was never so great as to produce a negative phase and, therefore, never in excess.

It was observed during these investigations that in some bloods examined, tuberculo-agglutinins appeared in association with the immune tuberculo-opsonins. This must be taken as another evidence of an immunizing response on the part of the organism. When the difficulties of such a method of treatment and the danger of the weapon employed are taken into consideration it will be readily understood that every now and then, in spite of the most careful supervision, an excessive auto-inoculation must take place. Such an over-dose is readily recognized clinically. A patient doing well on the grade of work prescribed for him and with no abnormality of temperature suddenly complains of feeling tired, of loss of appetite and of headache; and the temperature chart registers an elevation to 99° or 100° F. These are precisely the symptoms which are found during the negative phase after an excessive dose of bacterial vaccine.

Thus we have a new scientific test by which the effect of physical exercise on the blood of patients has been traced. As Inman says:

The opsonic index has shown that the exercise has supplied the stimulus needed to induce artificial auto-inoculation, and that this systematic graduation has regulated this in point of time and amount. This co-operation with the natural efforts of the blood has enabled Dr. Paterson to send his patients back to their accustomed work, however hard it may be. But the investigation has done more than explain a successful mode of treatment. Dr. Paterson agrees with me that with the aid of the opsonic index he can regulate the stimulus with scientific accuracy and obtain his results more certainly and more rapidly. This, of course, involves work in the laboratory. But it also means a more rapid and a more certain discharge of the patient which is the main object of the sanatorium.

Fresh air, exercise, and proper food seem then to constitute the foundation of successful treatment of tuberculosis. The improvement of the general condition of the patient and life in the open air evidently needs to be supplemented by certain exercise so as to produce a series of auto-inoculations and probably the best method yet devised is by the system of graduated labor just described.

All sorts of exercises such as horseback riding, golfing, light dumb-bell exercises and other calisthenics have been practiced for many years in treating tuberculosis; walking exercises have been the feature of some of the German sanatoria referred to; patients sent to the western states and territories almost invariably practiced outdoor exercises, some with great harm and some with benefit. Neither physician nor patient in most instances regulated these exer-

cises intelligently, but groped in the dark, never dreaming of the underlying principles as explained by laboratory studies of Sir Almroth Wright, Paterson, Inman, and others. We trust that further studies and the application of the same method in Europe and America will fix the value of exercise in tuberculosis.

A somewhat similar system of graduated labor has been adopted in the King Edward VII Sanatorium near Midhurst, England. Light work in the gardens and grounds is prescribed in lieu of some of the walking exercise and forms part of the regular treatment. Practical gardening in the grounds and flower beds is utilized. The lightest labor consists of weeding, hoeing and edging paths and borders, gathering seeds, plucking dead flowers, pruning, etc. Somewhat harder exercise consists in wheeling soil to the lawns and spreading it, clearing ground of stones and taking them away in barrows, and in leveling new ground after being broken up. The heaviest work is that of digging and trenching unbroken ground, moving, rolling, etc. Paths through the pine woods have also been constructed. In this particular work the breaking up of the ground with picks and clearing away the roots from neighboring trees was allotted to the first division of patients. The second division cleared away the broken ground and roughly leveled it. The third division finished the leveling of the paths with rakes and tidied up the edges.[1]

Free patients at the King's Sanatorium have made a cinder tennis court; they have cut down and sawed fire wood; they have an open air carpenter shop and an instructor in carpentry, who is himself a patient; they care for the poultry and make the runs for the fowls. In this way patients are constantly occupied.

Although the system of graduated exercises, or labor, adopted at the sanatoria referred to, has attracted wide notice and its principles were there first placed on a highly scientific basis, there were previous attempts to do this in an intelligent and rational manner. Sir Robert Philip, at Edinburgh, over twenty years ago, before the bacteriology of tuberculosis had been so well developed, prescribed practically the same thing as a therapeutic measure of definite dosage. He had had classes of selected patients who came at fixed hours to take regular training with regard to posture and healthy respiratory movement. More especially the young were taught the value of a healthy form of chest, the principles of nose-breathing and full diaphragmatic movement. "In addition to this, measured walks of varying amount and gradient were prescribed exactly

[1] Noel Dean Bardswell, Tuberculosis, Berlin, May, 1908.

as we prescribe medicines. Thus we had walks radiating from the dispensary round the meadows, walks over the Bruntsfield Links and walks in various directions on the slopes of Arthur's Seat. The patients reported, at successive visits, their experience in carrying out such instructions and notes were made of the effects produced." Here we see the germ of the class method so well developed and practiced by Pratt, of Boston, although he is an apostle of rest rather than labor.

The results in Philip's hands were eminently satisfactory. "The patients did remarkably well and no accident was traced to the adoption of active movement instead of rest. The experience led to a change in my outlook in relation to the meaning of treatment in tuberculosis." Philip came to the conclusion that by the establishment of hospitals or sanatoria for patients in the earlier stages of tuberculosis "we might hope to achieve permanent cures to a degree not dreamt of, by elaboration of the principle of regulated exercises and graded activity of all kinds." These conclusions were justified by the results obtained "in the home treatment undertaken for so many years at the Victoria Dispensary and in the systematized *régime* of work at the Royal Victoria Hospital and the recently opened Farm Colony."

Sir Robert Philip lays great stress on the well-known fact that there is a progressive intoxication in tuberculosis and the toxins produced by the tubercle bacillus appear to exert their vicious influence particularly on the neuromuscular apparatus. The toxin is especially a muscle poison.[1] There is a visible and palpable progressive wasting of the muscles, both of the trunk and the extremities, with advancing flaccidity and increased myotatic irritability. It is an expression of malnutrition, a muscular dystrophy dependent on intoxication. The obvious conclusion is that by the institution of natural movements the physiologic cure of "recreation" is assisted and health gradually returns.

Sir Robert's scheme of physical treatment at the Royal Victoria Hospital is worthy of mention. On admission each patient is placed at complete rest. During this stage, in addition to minute examination of every organ, the patients general condition is carefully observed. According to the estimate which is made the length of the resting period is fixed. Thereafter, in the absence of counter-indication, the patient is gradually advanced through the other stages.

[1] R. W. Philip, Trans. International Med. Congress, Washington, 1887, Vol. 1, p. 205.

The dose of exercise is increased or diminished as the temperature chart, pulse rate and other indications suggest. A colored badge is given to the patient to denote the stage he has reached.

I. Resting Stage, as noted above. (White Badge.)

II. Stage of Regulated Exercises. (Yellow Badge.) This includes (1) walking ¼ to 5 miles; (a) on the level; (b) on sloping ground. (2) Various respiratory exercises once or twice a day. (3) Other forms of movements to improve carriage of shoulders, head, chest, etc.

III. Stage of Regulated Work. (Pale Blue Badge.)

IIIA. Picking up papers, leaves and other light rubbish on the grounds; knitting; sewing; drawing.

IIIB. (Green Badge.) Emptying waste garden boxes and assisting to carry away rubbish. Carrying light baskets for various garden purposes. Light painting work, wiping shelters; setting tables and laying cloth in patients' dining room; cleaning silver, brasses, taps, etc.

IIIC. (Deep Blue Badge.) Raking, hoeing; mowing; sweeping leaves; light wheel-barrow; heavier painting work; sweeping shelters; scrubbing floors; cleaning knives; assisting in laundry; washing dishes.

IIID. (Red Badge.) Digging; sawing; carrying heavy baskets for various gardening purposes; wheeling and drawing full wheel-barrow and other heavy gardening work. Window cleaning and polishing floors; sweeping and cleaning court yard. Carpentering; joinering; engineering; attending boiler; errands.

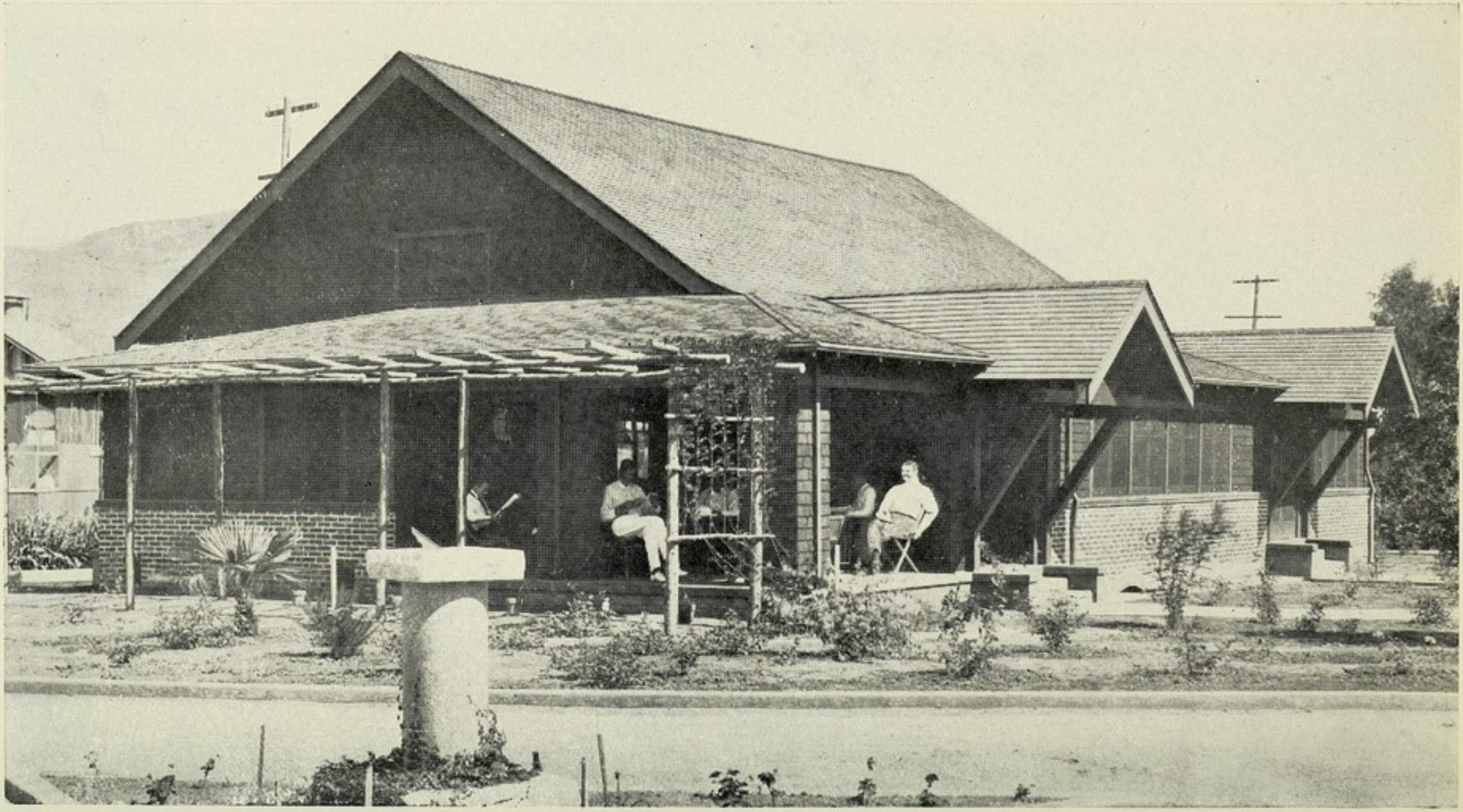
An institution providing diversified occupations has a great advantage over one whose patients are restricted to walking exercises and where the women are employed in kitchen work and the men as laboratory orderlies, assistants in the drug rooms, clerks and so on. It is well to vary the walking exercise with manual labor. Patients welcome it and take a great interest in the various occupations they are put to. They acquire confidence in themselves as they see their muscular tone improving and some prospect of resuming useful occupations.

With various modifications suggested by local conditions the system of graduated labor described above is now adopted at various institutions in America; in many cases, however, the economic aspect of the plan of treatment apparently overshadows the therapeutic features; probably the best examples of the method are at the Loomis Sanatorium, New York, Otisville State Sanatorium, New York, The Adirondack Cottage Sanitarium, New York, The North Reading State Sanatorium, Massachusetts, and The Barlow Sanatorium, Los Angeles, California. Dr. Barlow has kindly sent me the following description of the method he has carried out:

This institution is semi-charitable and receives cases in all stages.

You ask me to send you a statement of our use of graduated labor. I will give you the facts as we handle the matter, which is somewhat modified to

TENT HOUSES. BARLOW SANATORIUM, LOS ANGELES, CALIFORNIA



BARLOW SANATORIUM, LOS ANGELES, CALIFORNIA

meet the needs of our institution. It seems to me that every institution must modify this according to the facilities at command. Our working plan is as follows:

All the patients without any fever are kept absolutely quiet for the first two or three weeks, except that they are allowed to go to the dining room for meals. If, during this time, there is no elevation of temperature, no marked acceleration of pulse, and no loss of weight, they are started on exercise, beginning with ten minutes' walking twice a day. If they continue to do well, gain weight, temperature remains normal, and progress of physical signs is favorable, then exercise is increased every two weeks. The amount of exercise is charted for each patient; one copy posted on the bulletin board, and one copy retained by the nurse in charge of the order, to check up the allowance for each patient. Patients who have more than ten minutes' exercise twice a day make their own beds and keep their rooms in order, except the heavy cleaning. After patients have reached an allowance of thirty minutes twice a day, they are assigned to more practical work about the place or grounds. In making these assignments, the patient's physical condition and progress, former, and probably future, occupation are considered. Most of these assignments are changed each month, the effort being to try to increase the work each month. The work done includes the setting of tables in the dining room, removing and washing dishes, work in the diet kitchen, looking after books and pamphlets in the library, cataloguing books, statistical work, stenography and typewriting, carrying mail, light repairs about buildings, care of paths and summer-houses, sprinkling during dry weather, and operating the incinerator. Many patients are assigned to flower beds of their own, or to doing light work in caring for the sanatorium grounds. In carrying out this exercise or labor, careful watch is kept over patients, and if any elevation of temperature, acceleration of pulse, or extension of physical signs are observed, they are put back to rest. The purposes that this exercise and labor seem to serve are, recreation, stimulating the appetite and digestion, building up healthy tissue, inducing healthy sleep, and testing the patients against relapses when they resume their normal way of living after being discharged. We find that patients who accept the occupation cheerfully make better progress mentally and physically than those who resent being assigned to duties.

For patients with an elevation of temperature 99° or over, acceleration of pulse, either loss or no gain in weight, or who do not show improvement in other ways, rest is continued, and exercise or assigned work is deferred.

At the present time (December 11, 1913), there are 43 patients in the sanatorium. Ten are in the infirmary; thirty-three in open-air cottages; of the latter twenty-seven are doing their own work, and twenty-five additional assigned work. Of the six in open air cottages not doing their own work, three are new patients who have been recently admitted and not under observation a sufficient time for report.

REFERENCES TO WORKS ON EXERCISE AND WORK

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Lawrason Brown and F. H. Heise: Properly Regulated Rest and Exercise in Pulmonary Tuberculosis (Journal of the Out-Door Life, August, 1912).

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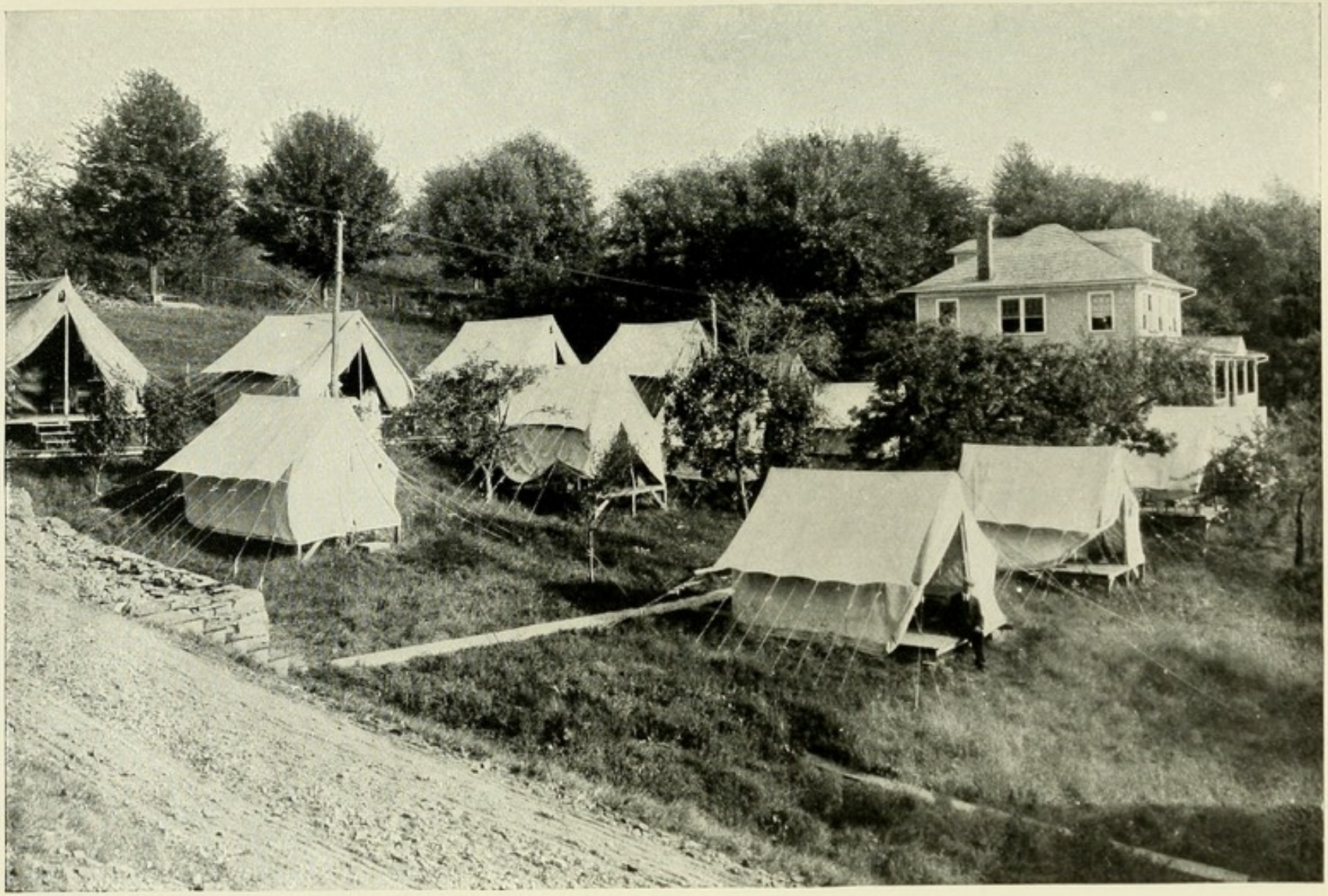
M. Paterson: Treatment of Pulmonary Tuberculosis by Graduated Rest and Exercise (Practitioner, January, 1913).

C. C. MacCorison and N. B. Burns: Method of Recording Exercise Data in Sanatorium for Consumptives (Boston Med. and Surg. Journ., May 9, 1912).

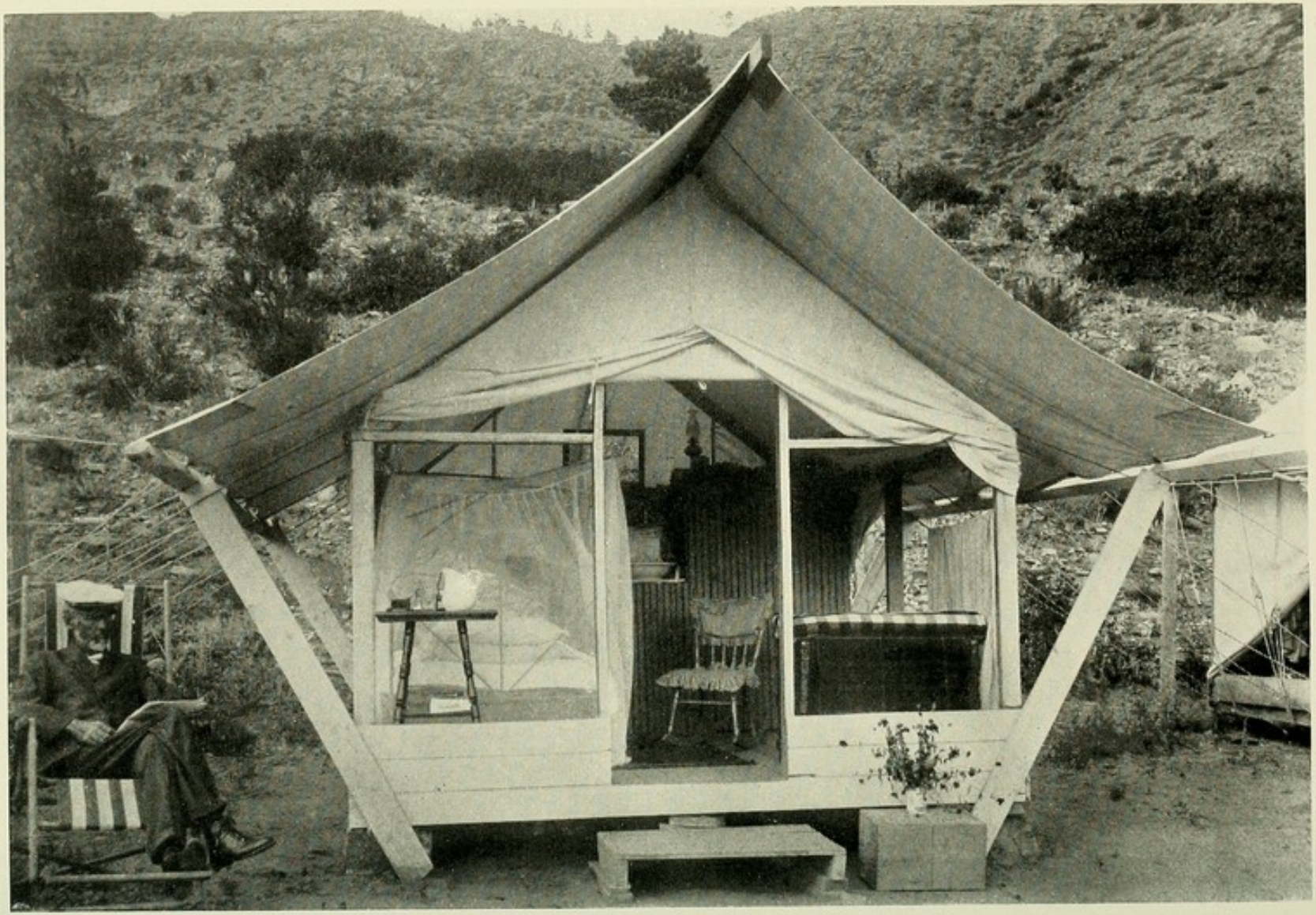
CHAPTER IX. ACCESSORIES FOR THE FRESH AIR TREATMENT OF TUBERCULOSIS

It would be impossible to carry out the fresh air treatment of tuberculosis without some special facilities or accessories. These vary somewhat in accordance with the plan of treatment, whether singly or collectively; or in cities, forests, or plains. Among these accessories we include: (1) Tents; pavilion tents. (2) Tent houses; shacks, "lean-tos." (3) Disused trolley cars. (4) Balconies or leigeterrasse for day use. (5) Day camps. (6) Sleeping porches or balconies. (7) Wooden pavilions. (8) Glass pavilions. (9) Hospital roof wards. (10) Detached Cottages. (11) Sleeping canopies.

Tents.—Tents have the advantage of low cost, portability, and the fact that they are adapted for almost any locality, whether in the city, the forest, or the plains. In the city a tent for the use of a tuberculous patient usually attracts too much notice and unfavorable comment unless placed in a rural district. It is possible, however, to erect tents in the heart of a great city, hundreds of feet above the ground where an abundance of pure air and sunlight are obtained. The modern hotel or office building can furnish a far better site, in these particulars, than many rural districts. The author is not aware of any extensive use of tall buildings for the treatment of pulmonary tuberculosis, but it would seem to be an entirely feasible proposition.



TENTS FOR TUBERCULOUS PATIENTS, SUNNYREST, WHITE HAVEN, PENNA.



ESTES PARK, COLORADO. CHEAP BUT COMFORTABLE TENT FOR SUMMER USE
Courtesy of Dr. S. G. Bonney

Anyone who will read the interesting story by Van Tassel Sutphen entitled "The Negative Pole,"[1] will find the history of an interesting case of pulmonary tuberculosis cured by residence of eighteen months on the top of a modern "skyscraper." The patient had been advised to remove to Arizona, but circumstances made this advice impossible to follow; as an alternative measure he isolated himself almost entirely from the world in the midst of a metropolis, and was rewarded by a complete cure. The imaginative author of this original story assigns to the patient a much more difficult rôle than need be assumed by anyone who may follow the general line of treatment and perhaps we may hear of many who may be encouraged to carry out the plan suggested.

In the forest during the warmer season tents are almost indispensable. A substantial tent properly erected, protected with a "fly" and with a surrounding trench to provide for excessive rainfall, can be made a comfortable and healthful habitation during a large part of the year.

The ventilation of tents, and their heating in cold weather, have received a great deal of study, and as they are perfected in these respects their suitability for a continuous residence throughout the year has been proved. Tents can be made storm proof and almost as comfortable in stormy weather as an ordinary building. On Blackwell's Island and on Ward's Island, New York City, tents are in constant use, with astonishing success for tuberculous patients.

At the Manhattan State Hospital East, for the insane, Ward's Island, New York City, the late Dr. A. E. Macdonald instituted, in 1901, a tent colony for the tuberculous patients.

This experiment resulted most favorably and led to the extension of the outdoor treatment to other classes of the insane besides the consumptives. For thirteen years the consumptive insane on Ward's Island have been treated in tents and pavilions. Tuberculous infection has been removed from the wards and 11.39 per cent of patients are reported to have had their tubercular disease arrested. They almost invariably gained flesh; one is reported to have gained 79.5 lbs. (Eighth Annual Report, Manhattan State Hosp., New York.) In the Eighth Annual Report the following comment is made: "In our experience the winter months have proven to be the most favorable for these patients, despite popular opinion to the contrary, and likewise it is seen that the summer month of July was in a decided manner proven to be the least favorable of the year."

[1] Harper's Magazine, July, 1908.

The accompanying illustrations show fully the initial stage of this experiment in a portion of New York City having many natural beauties. But in the course of time it was apparently realized that the same results might be obtained with other structures of a more permanent character and I am informed by Dr. William Mabon, the superintendent and medical director, that the tents have been replaced by wooden and glass camps. The reason for this change is that the tents were found to be very close and unsatisfactory in wet weather, whereas the wooden camps can be opened and ventilated under all conditions of weather.

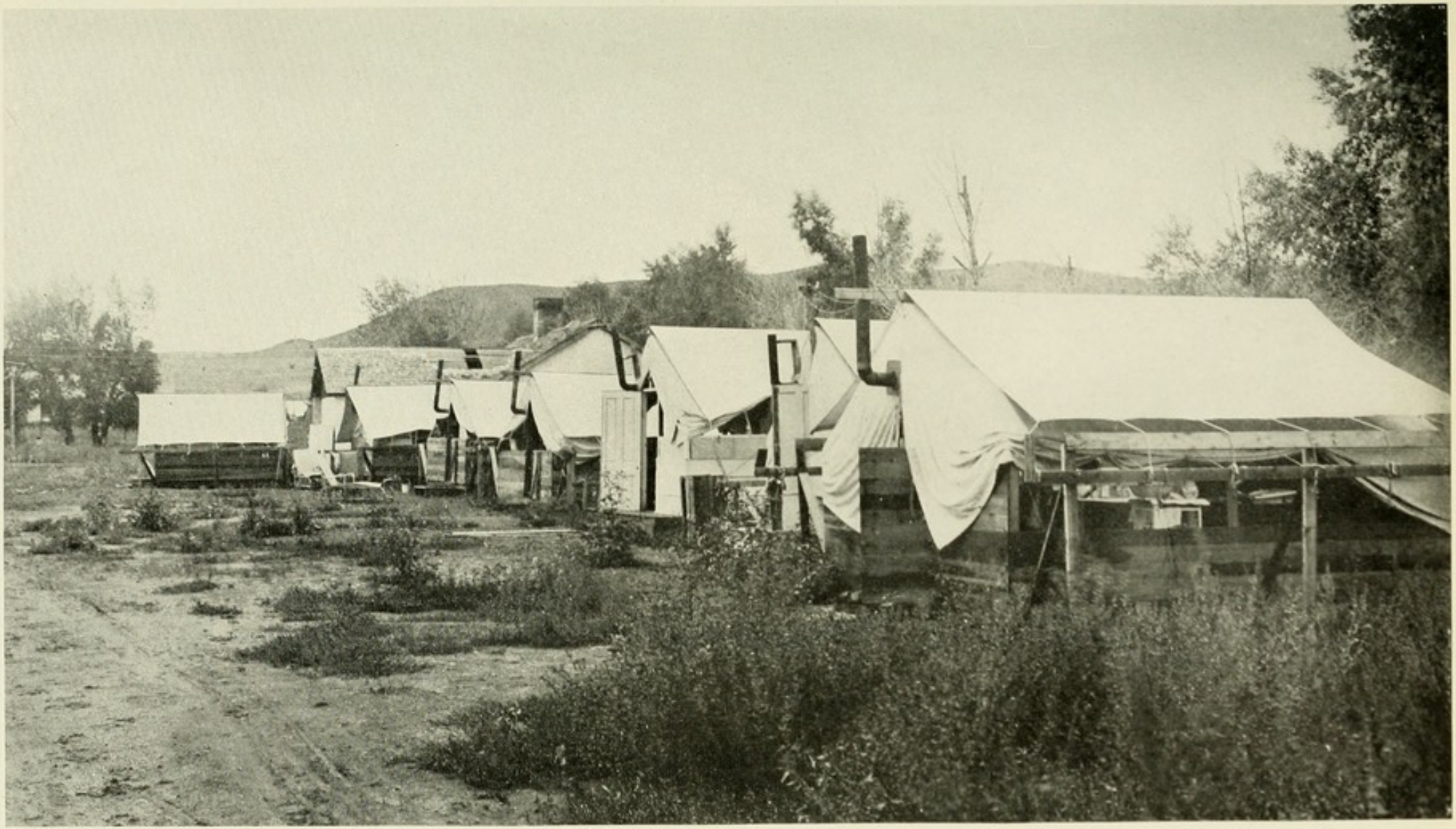
Pavilion Tents.—On Blackwell's Island, New York, the Metropolitan Hospital makes use of twelve pavilion tents with a capacity for 142 patients. Steam pipes are arranged in a double circuit and in some cases stoves render these pavilion tents comfortable in winter and were preferred by the majority of the patients, in the coldest weather, to the ordinary quarters in the main building of the hospital. These pavilion tents were devised by Dr. A. M. Holmes, of Denver.

The tent devised by Dr. Charles Fox Gardiner, of Colorado Springs, is largely used in western sanatoria and has some notable advantages. It is of conical shape, like the Sibley army tent, with a ventilator at the apex of the cone which may be opened or shut. The board floor has an air space beneath and air inlets opening at the floor between the interior wainscoting and the tent wall supplying air at the height of three or four feet above the floor. This is an improvement over the method of allowing air to enter at the floor. These inlets are controlled by hinged lids. This tent avoids the use of a center pole, pegs, or guy-ropes, as it is supported by two-by-four-inch timbers reinforced by angle irons and plates. This tent costs from $90 to $100 and is thoroughly practical. It is not unlike the Nordrach tent. (See plate 55.)

The tent devised by Dr. H. L. Ulrich, of Minneapolis, is simpler and less expensive. It consists of a wall tent with ridge pole for the tent, and another 12 inches clear above it for the "fly." There are ventilating openings on either side of the tent ridge. The tent and "fly" are secured by guy-ropes and pegs and all four sides may be rolled up and lowered as required. A stove may be used in cold weather. A tent 10 by 12 feet costs $22.50.

Other excellent tents have been devised by Prof. Irving Fisher, of New Haven, Dr. Mary Lapham, of Highland, N. C.,[1] and Dr. James A. Hart, of Geneva, New York, and Colorado Springs.

[1] American Medicine, Phila., 1905, Vol. 9, 517.



UNITED STATES PUBLIC HEALTH SANATORIUM, FORT STANTON, NEW MEXICO. SHOWING TENTS OCCUPIED BY CONSUMPTIVE EMPLOYEES

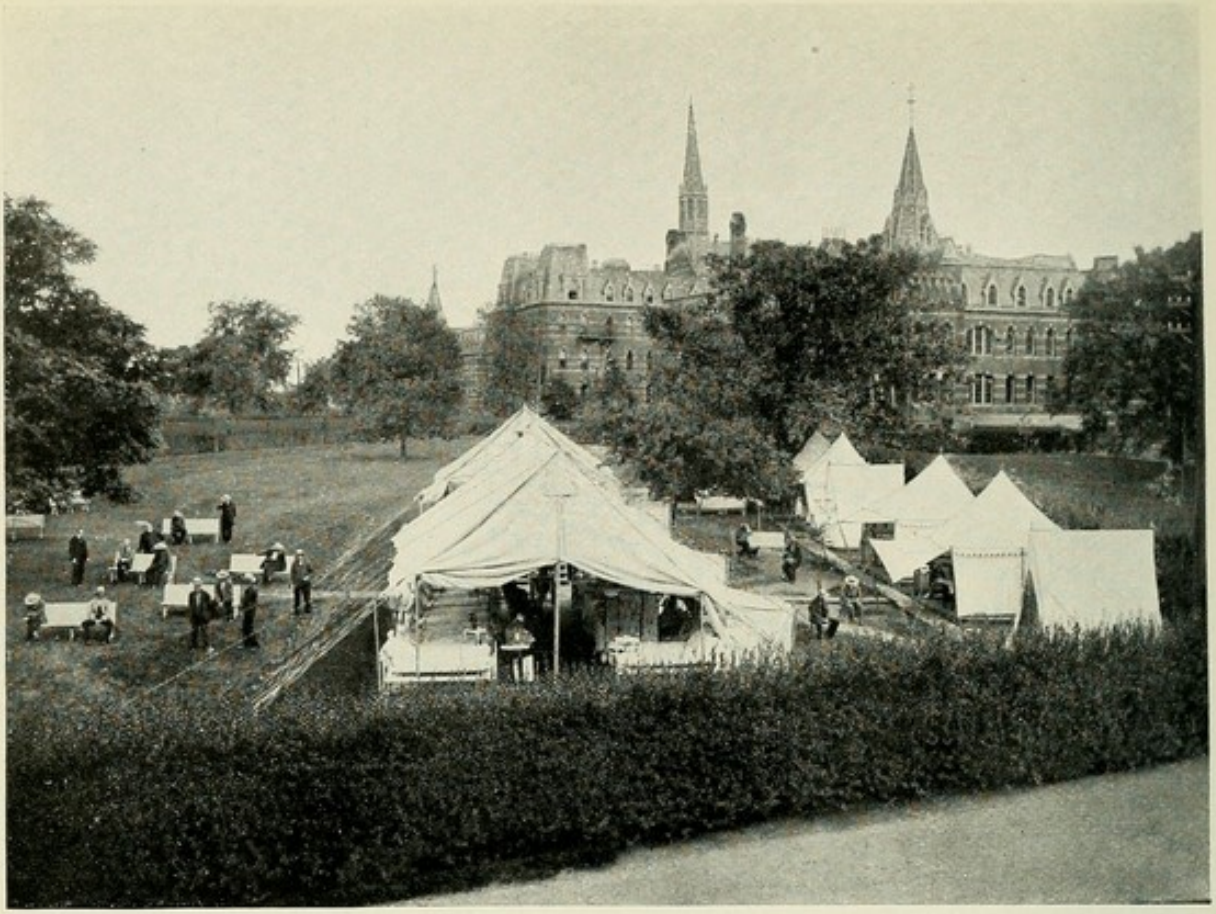


FIG. 1. MANHATTAN STATE HOSPITAL, EAST, WARD'S ISLAND, NEW YORK CITY. TENTS FOR THE TUBERCULOUS INSANE

FIG. 2. MANHATTAN STATE HOSPITAL, EAST, WARD'S ISLAND, NEW YORK CITY. CAMP C, FOR DEMENTED AND UNCLEANLY TUBERCULOSIS INSANE PATIENTS

FIG. 1. MANHATTAN STATE HOSPITAL, EAST, WARD'S ISLAND, NEW YORK CITY. TENTS FOR THE TUBERCULOUS INSANE. SUMMER LOCATION

FIG. 2. MANHATTAN STATE HOSPITAL, EAST, WARD'S ISLAND, NEW YORK CITY. CAMP A, FOR THE TUBERCULOUS INSANE. SUMMER LOCATION

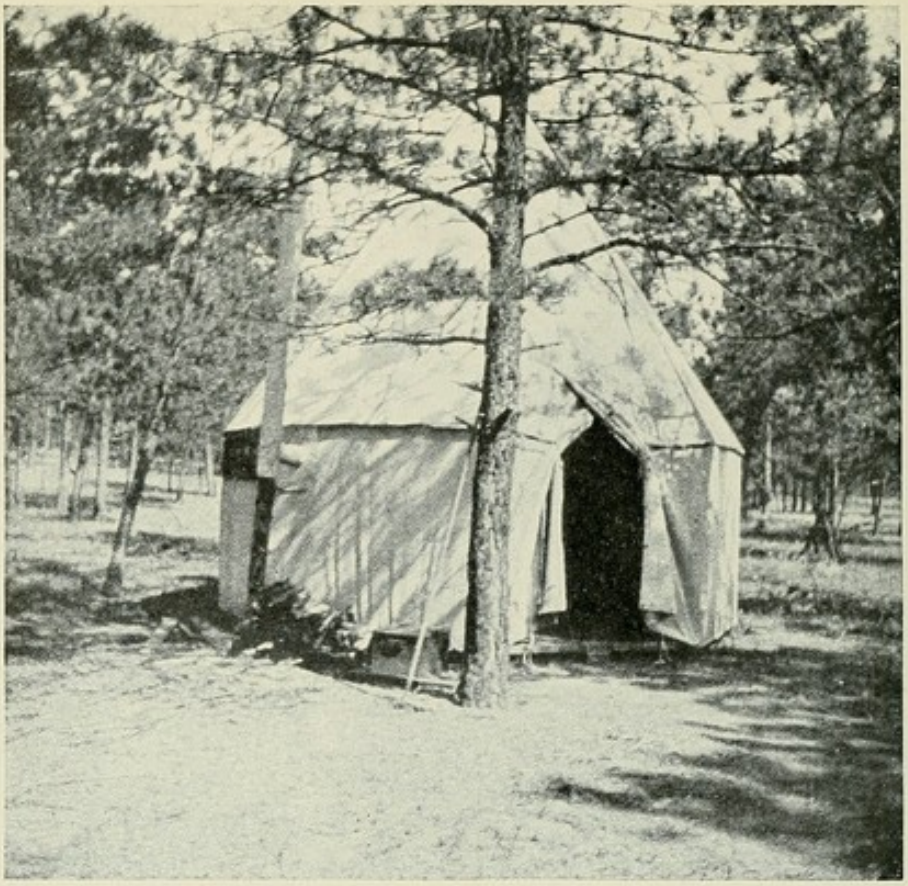


FIG. 1. TENT DEVISED BY DR. CHARLES F. GARDINER, COLORADO SPRINGS. SEE PAGE 122

FIG. 2. MANHATTAN STATE HOSPITAL, EAST . CAMP A. INSANE TUBERCULOUS PATIENTS. REVOLVING TENT CONSTRUCTED SO AS TO BE EASILY TURNED IN ACCORDANCE WITH THE DIRECTION OF SUN AND WIND.

ROYAL VICTORIA HOSPITAL FOR CONSUMPTION, EDINBURGH. SHELTERS ARRANGED FOR NIGHT USE. THESE ARE USED ALL THE YEAR ROUND

Courtesy of Sir Robert Philip

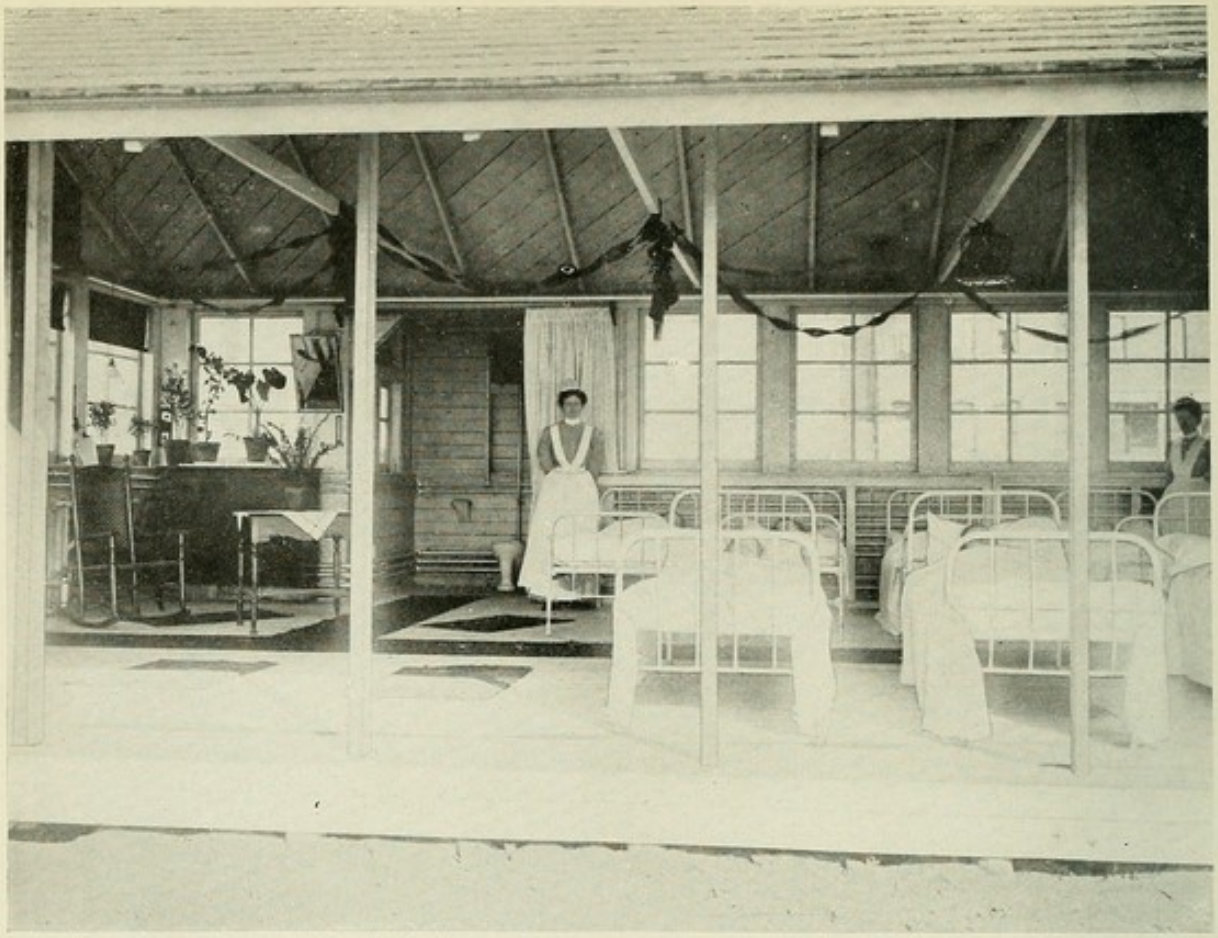


FIG. 1. MANHATTAN STATE HOSPITAL, EAST, WARD'S ISLAND, NEW YORK CITY. NEW OPEN SHELTER FOR THE TUBERCULOUS INSANE

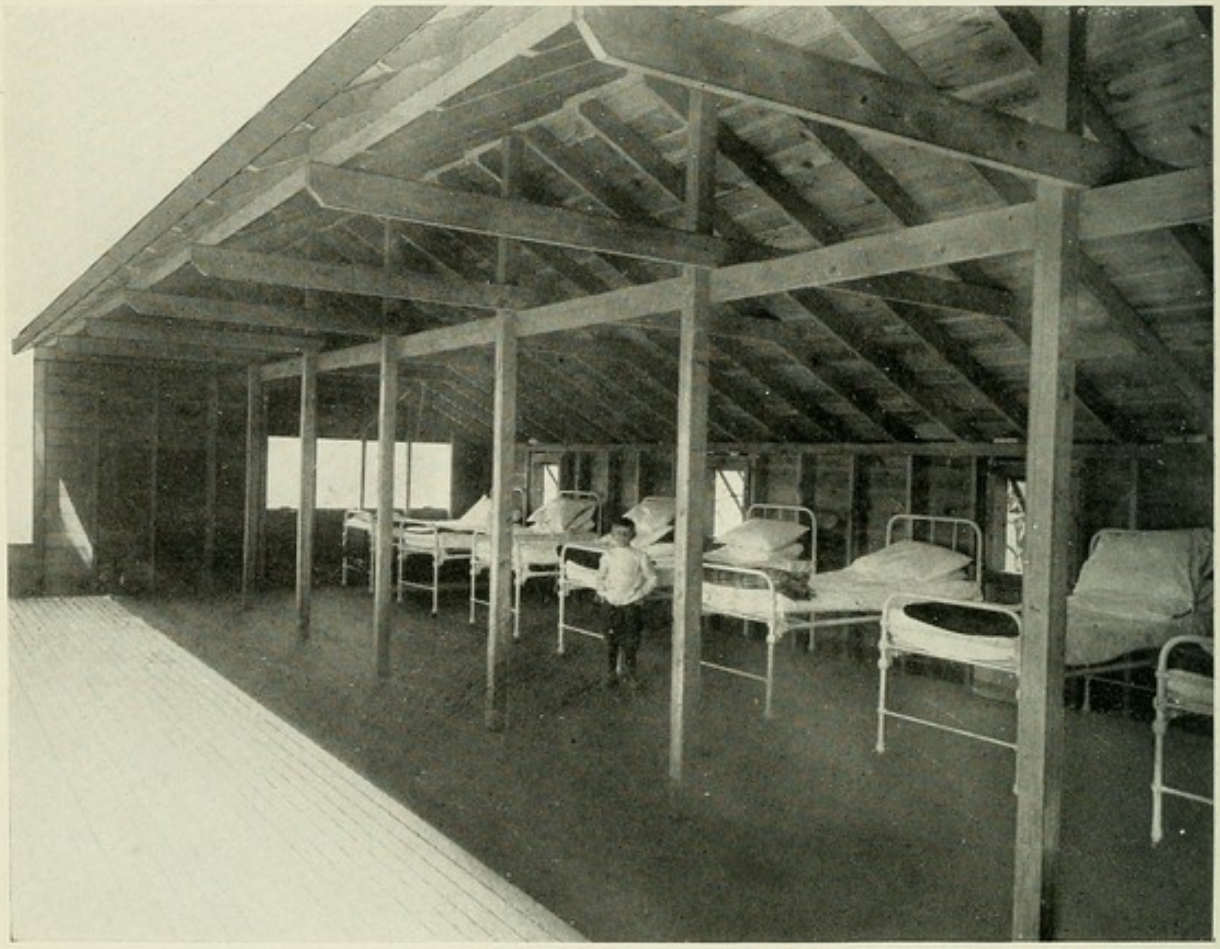
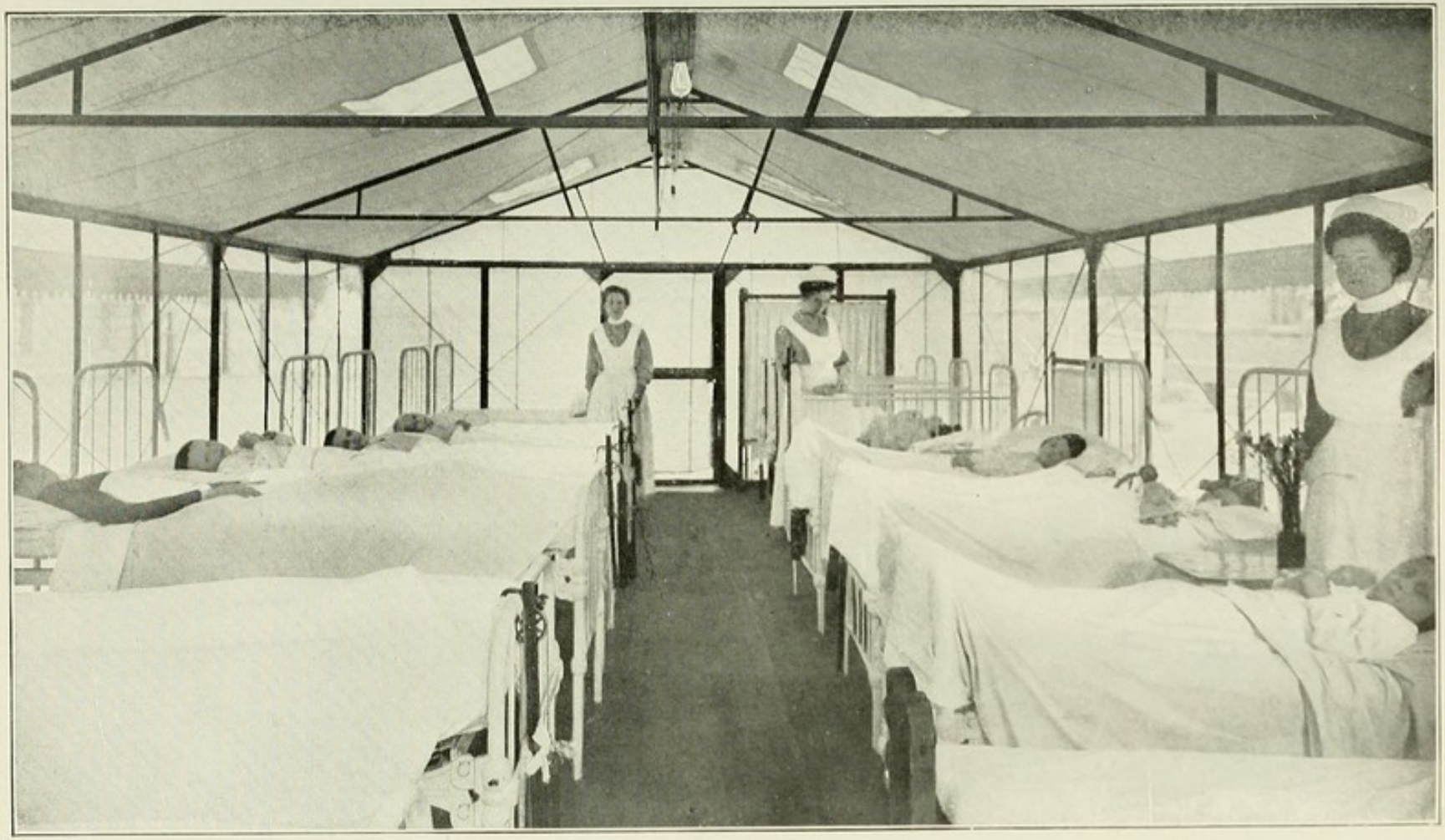
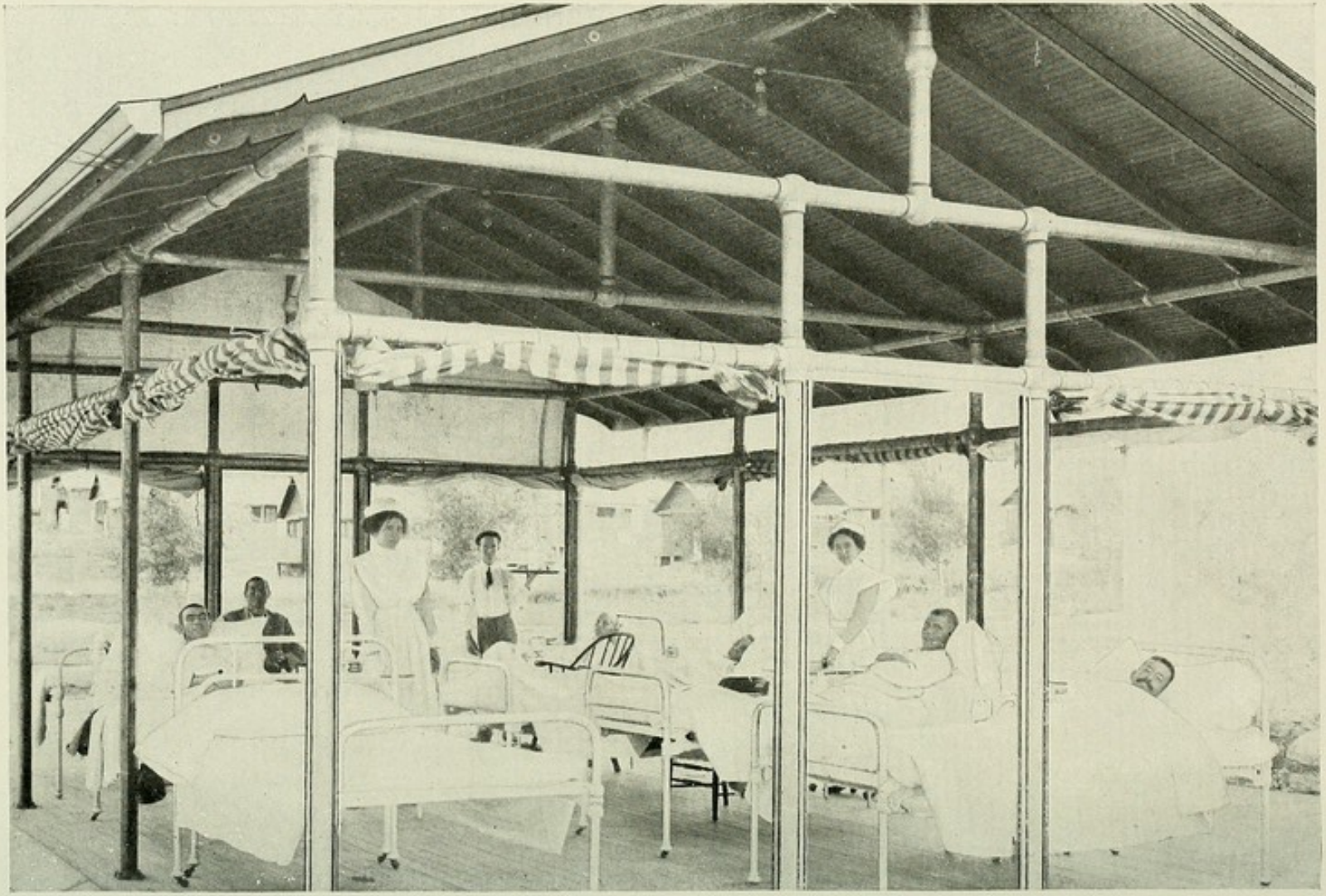


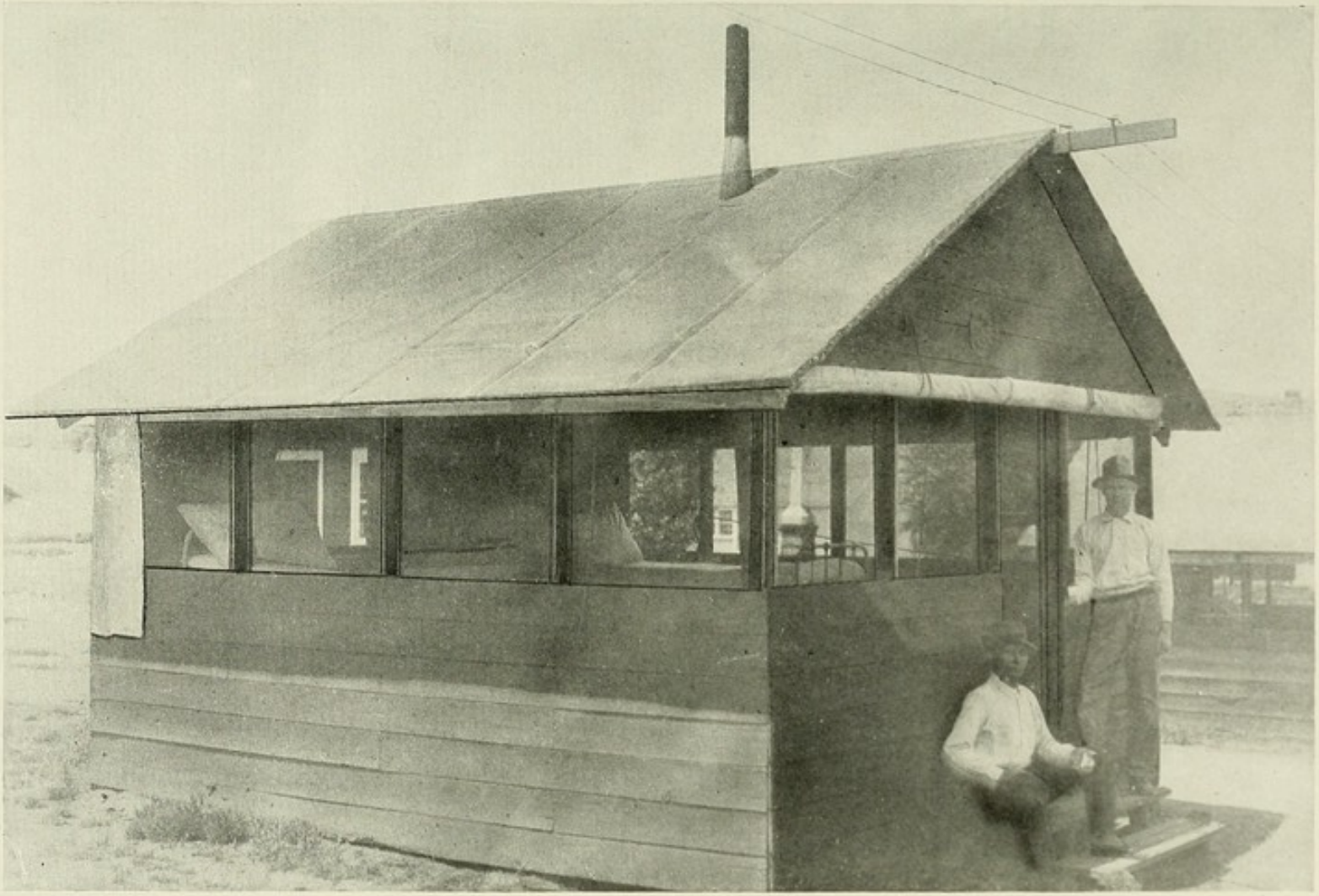
FIG. 2. LOOMIS SANATORIUM, SULLIVAN COUNTY, NEW YORK. SLEEPING GALLERY IN GUILD LEAN-TO



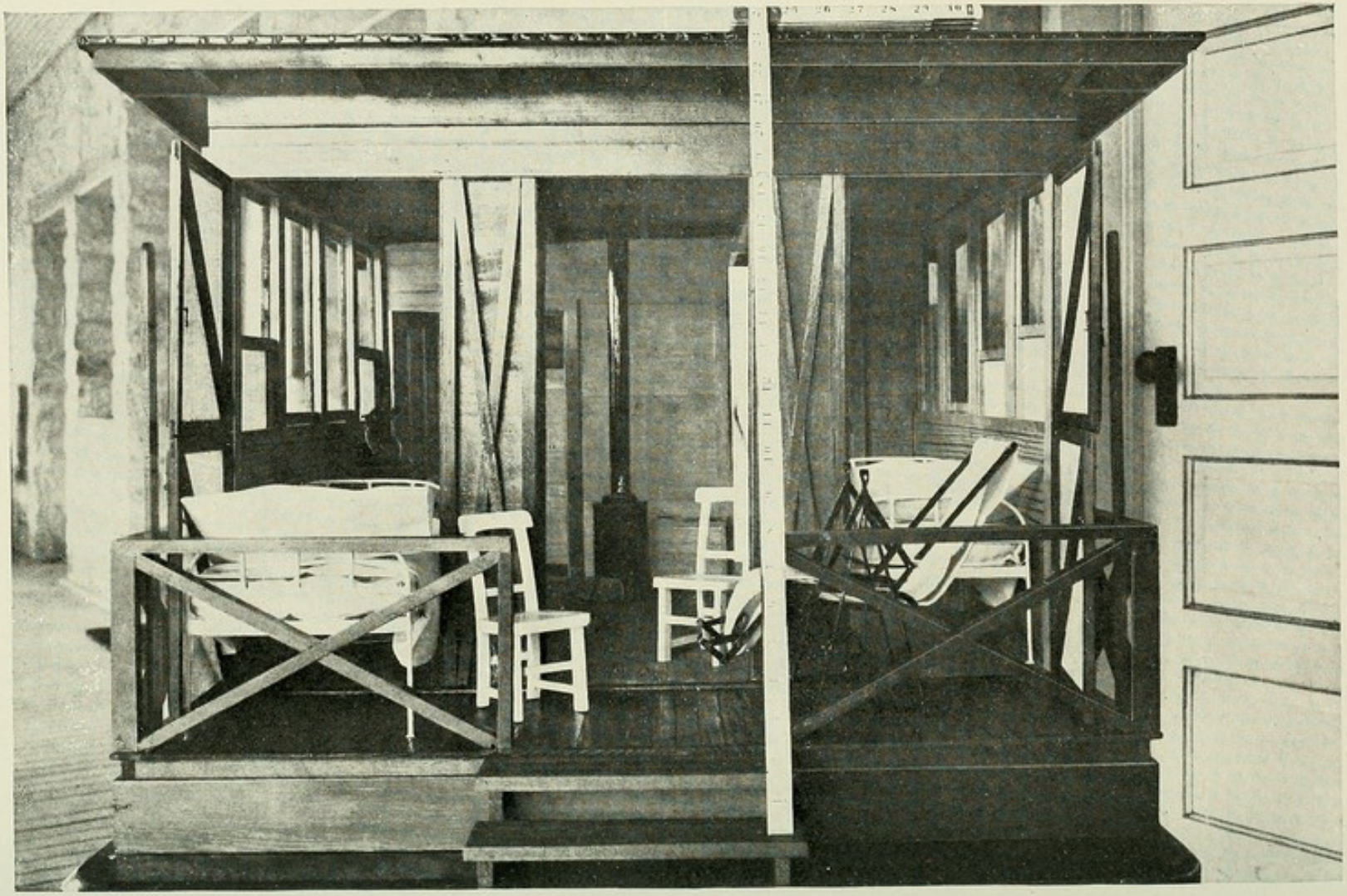
INTERIOR VIEW OF OPEN AIR COTTAGE USED BY STATE HOSPITAL FOR CRIPPLED AND DEFORMED CHILDREN, AT ST. PAUL, MINNESOTA
A PERFECT OPEN AIR TREATMENT. PATIENTS PROTECTED FROM SUN, FLIES AND MOSQUITOS
Courtesy of the Metal Screened Cottage Company, St. Paul



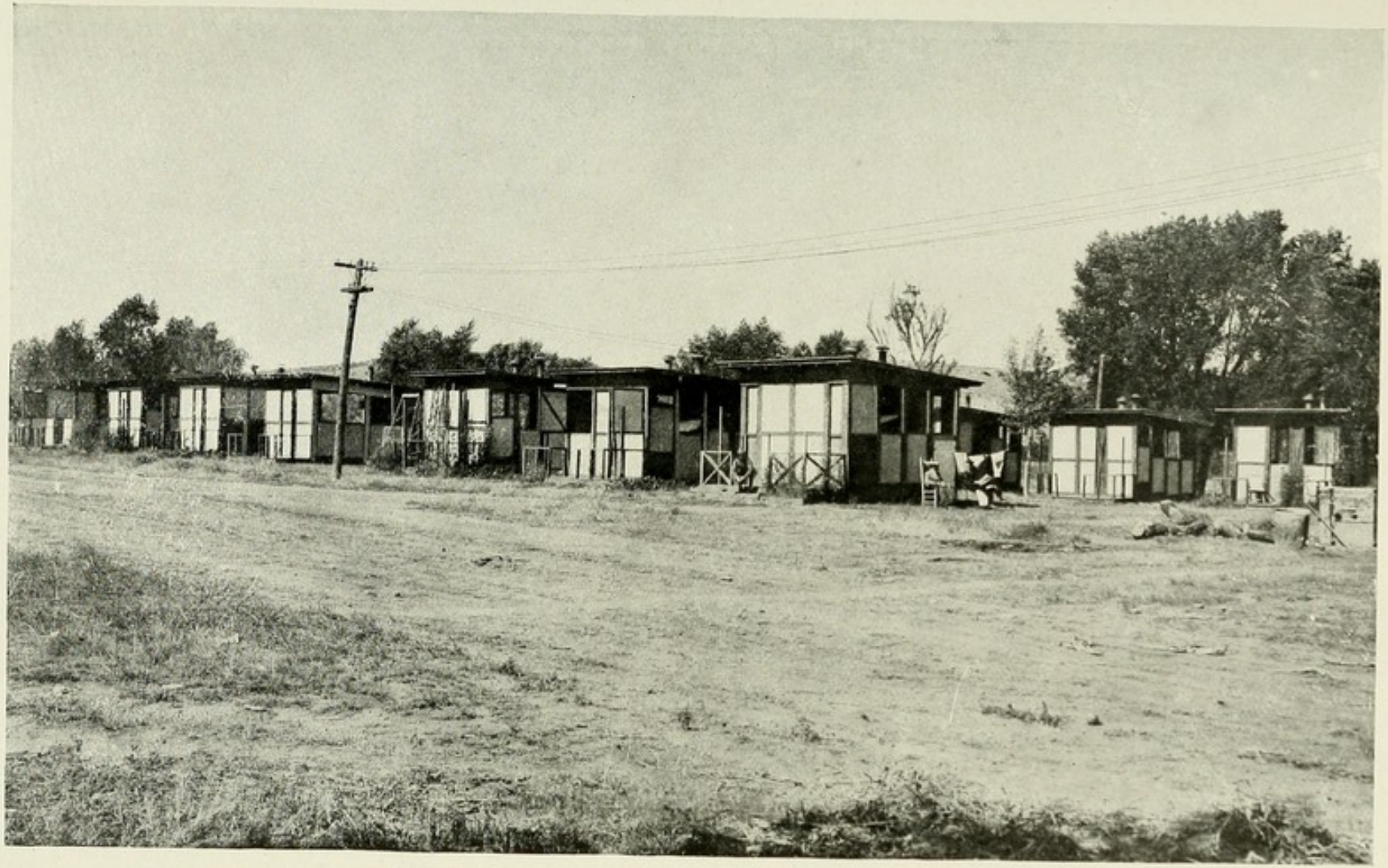
BED SHELTER, UNITED STATES PUBLIC HEALTH SERVICE SANATORIUM FORT STANTON, NEW MEXICO, 1912



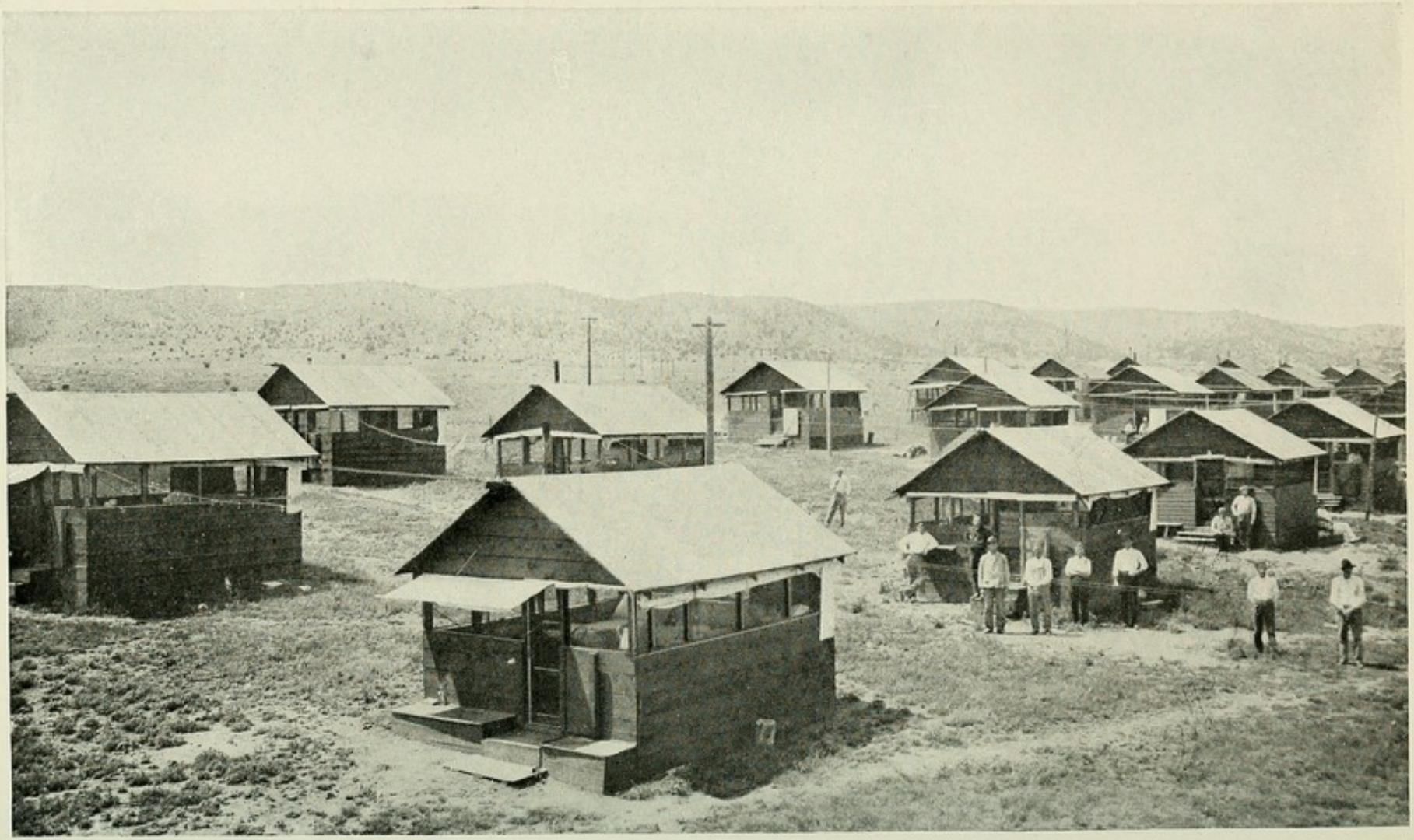
TENT HOUSE, TYPE B UNITED STATES PUBLIC HEALTH SERVICE SANATORIUM, FORT STANTON NEW MEXICO, 1912



MODEL OF TENT HOUSE, TYPE A, USED AT THE UNITED STATES PUBLIC HEALTH SERVICE SANATORIUM, FORT STANTON, NEW MEXICO, 1912

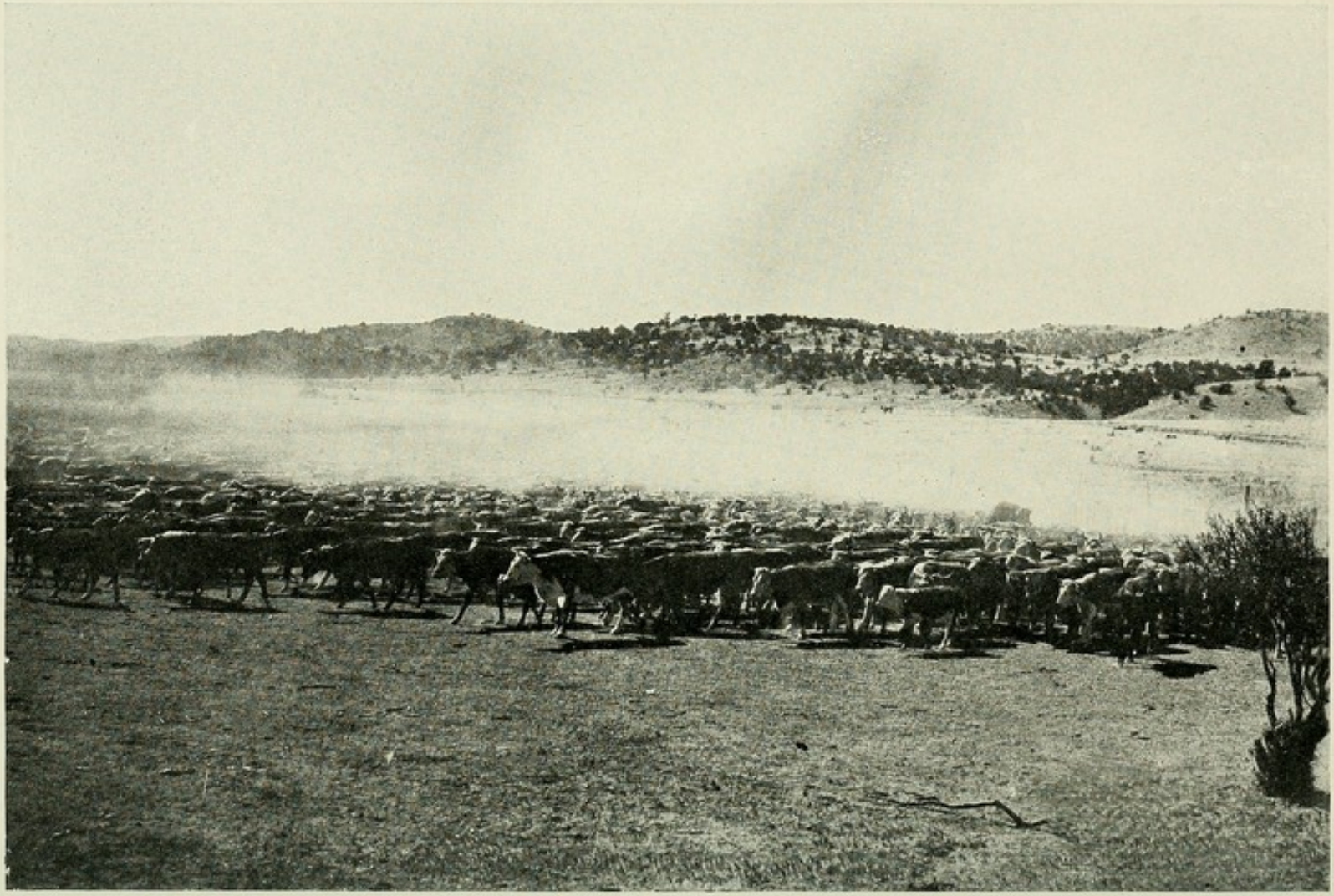


TENT HOUSES, TYPE A, UNITED STATES PUBLIC HEALTH SERVICE SANATORIUM, FORT STANTON, NEW MEXICO, FOR MASTERS, PILOTS AND ENGINEERS



TENT HOUSES, TYPE B, UNITED STATES PUBLIC HEALTH SERVICE SANATORIUM, FORT STANTON, NEW MEXICO

TUBERCULOSIS SANATORIUM OF THE UNITED STATES PUBLIC HEALTH SERVICE AT FORT STANTON, NEW MEXICO



SCENE IN NEW MEXICO, NEAR FORT STANTON. THIS HERD BELONGS TO THE SANATORIUM OF THE UNITED STATES PUBLIC HEALTH SERVICE

A "ROUND-UP" OF THE HERD BELONGING TO THE SANATORIUM FOR TUBERCULOSIS, UNITED STATES PUBLIC HEALTH SERVICE, FORT STANTON. A CHARACTERISTIC SCENE IN NORTHERN NEW MEXICO

DISUSED TROLLEY CARS WERE FIRST USED FOR CONSUMPTIVE PATIENTS BY DR. WILLIAM H. PETERS, OF PROVIDENCE, AT THE PINE RIDGE CAMP, RHODE ISLAND. THE CAMP CONSISTED OF SHACKS. PHOTOGRAPH SHOWS THE EFFORTS MADE TO PROVIDE THE OPEN AIR CURE BEFORE THE STATE SANATORIUM WAS BUILT

The evolution of the tent and open air shelter into the tent house, shack, and cottage, is an interesting feature of the open air treatment of tuberculosis.

"Lean-to."—The open air shelter and "lean-to" are somewhat alike. The latter has been long used by sportsmen and others in our northern forests, and has been greatly amplified for sanatorium purposes. The roof of the "lean-to" slopes directly back from its front or there may be a ridge placed close to the front or southerly side of the structure. The roof slopes well toward the back, but is short in front and allows free access of air and light. Canvass or screens are arranged to hang in front as a protection from wind or rain, and to insure privacy. For a full description of a "lean-to" the reader is referred to Dr. H. M. King's description with plans in "Some Methods of Housing," Charity Organization Society, New York.

Excellent "lean-tos" or open air shelters are in use all the year at the Royal Victoria Hospital, Edinburgh, Scotland, as seen in the illustration kindly supplied by Sir Robert Philip. (See plate 56.)

Pavilion tents are amplifications of the tent cottage, and are adapted for ten or twelve beds. As described by Mr. Homer Folks, they are sixteen by thirty-two feet long; the walls are eight feet high; the roof is fifteen feet high at the ridge and the floor of the tent is sixteen inches above the ground with free circulation of air underneath.

Tent Houses adapted for use in the New England and Middle States are naturally different from those in use in New Mexico and Arizona, where rain and snow are uncommon. The accompanying illustrations show a row of six tent houses and a single tent house at the U. S. Public Health Sanatorium at Fort Stanton, New Mexico, for consumptive sailors, under the care of the United States Public Health Service. The roof has a slight incline and the sides are arranged to give free ventilation as well as shelter when required.

Trolley Cars.—Superannuated and disused trolley cars were first used for tuberculosis patients by Dr. W. H. Peters, of Providence, Rhode Island, at the Pine Ridge Camp near that city. With slight alterations and at very little expense these cars may serve a useful purpose in connection with the outdoor treatment of tuberculosis at all seasons. Once located on a convenient site they have many advantages over the ordinary shack, affording a maximum of light and air and good protection against storms with their adjustable windows and doors. The author visited Pine Ridge Camp and can testify to

their efficiency; the camp itself was discontinued after the erection of the fine State Sanatorium for tuberculosis at Wallum Lake. Trolley cars were also used at the Camp Auxiliary, Montefiore Home, Bedford, New York. (See plates 67 and 68.)

The Balcony, or Liege-terrasse as it is known in Germany, is a necessary adjunct of any sanatorium for tuberculosis. Plate 71 shows a covered or partly sheltered balcony in use at a large private sanatorium in St. Blasien in the Black Forest, Germany. Plate 89 shows an open or uncovered balcony at the Sharon Sanatorium, Massachusetts. In June, 1908, the author visited the latter sanatorium with the Medical Director, Dr. Vincent Y. Bowditch, and can bear witness to the excellent arrangements for the outdoor treatment of tuberculosis carried out at this institution.

The records, now extending over 22 years, show that about 50 per cent of all cases, and 72 per cent of all incipient cases have been arrested or cured.[1] Of the 160 arrested cases treated between 1891 and 1906, 133 or 83 per cent were still living and well in 1908, most of them house-keepers and wage earners; in addition, 3.7 per cent were doing well at last accounts, but were not recently heard from.

We have given the particulars of these cases treated at Sharon Sanatorium because the results are remarkably good being obtained at an elevation of 250 feet above sea level, about 15 miles from Massachusetts Bay, and about 20 miles from Boston. Sharon is near enough to the ocean to be affected by the sea breeze during the hot weather.

Day Camps; Walderholungstätten.—The daily care of consumptives at a day camp for the outpatients of a general hospital had its origin about the same time in both Boston and Berlin. It was proposed by Dr. A. K. Stone and Dr. E. P. Joslin in 1905 in Boston, and provision was made at the Mattapan Day Camps and at the House of the Good Samaritan for ambulatory patients. Plates 72-74 show how this is carried out. In July, 1908, fifty consumptives too ill to be benefited by treatment at the Massachusetts General Hospital were transferred to the new home of the Boston Consumptives' Hospital on the Conness estate, Mattapan, and entered on treatment which it was hoped would culminate in their improvement to an extent that should warrant their entrance into the state institution. They went to the camp in the morning and returned to their homes

[1] See V. Y. Bowditch, Boston Medical and Surg. Journ., June 22, 1899.
See V. Y. Bowditch, Journ. Amer. Med. Ass., Nov. 14, 1903.
See V. Y. Bowditch, Trans. Amer. Climatological Ass., 1907, p. 168.

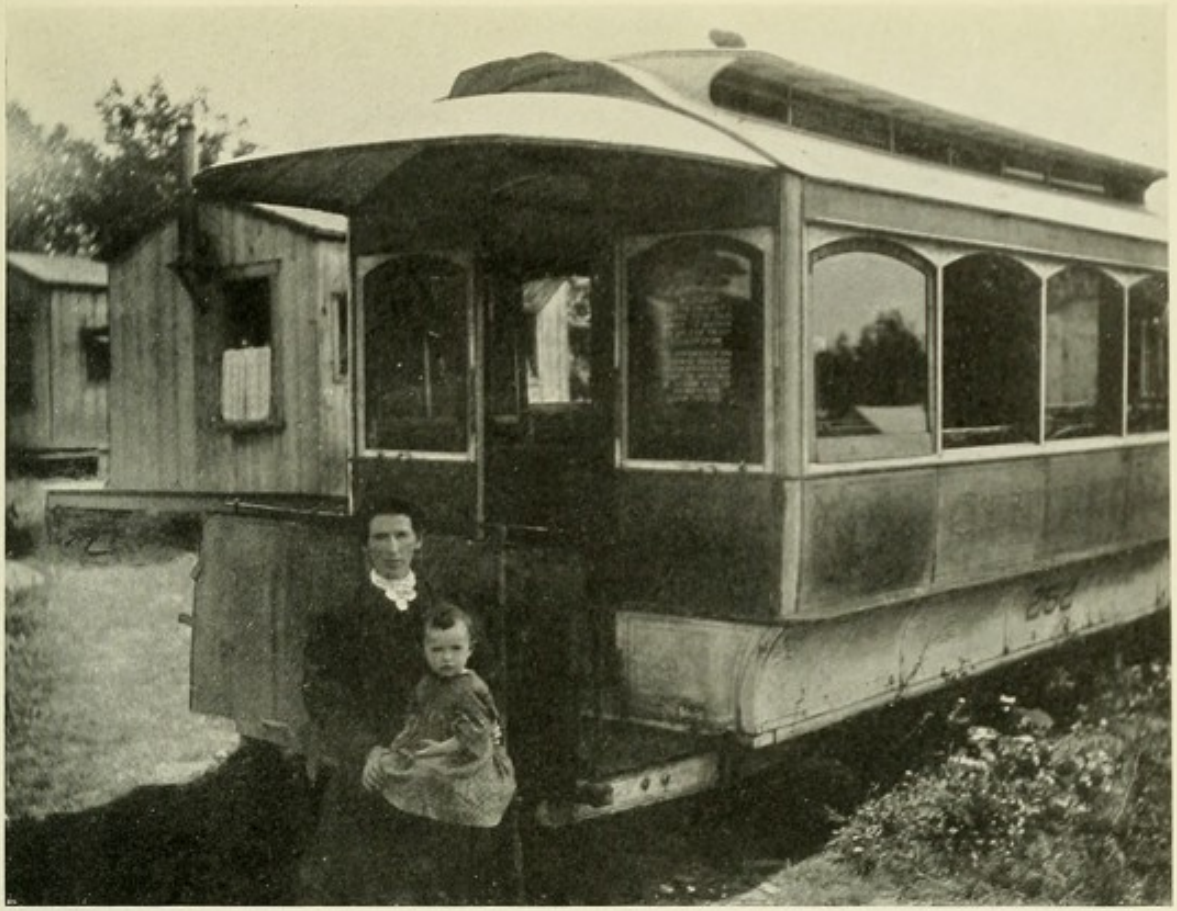


FIG. 1. OLD TROLLEY CAR THAT WAS USED BY MOTHER AND CHILD AT THE PINE RIDGE CAMP FOR CONSUMPTIVES, NEAR PROVIDENCE, RHODE ISLAND
Photograph by Courtesy of Dr. W. H. Peters, Providence

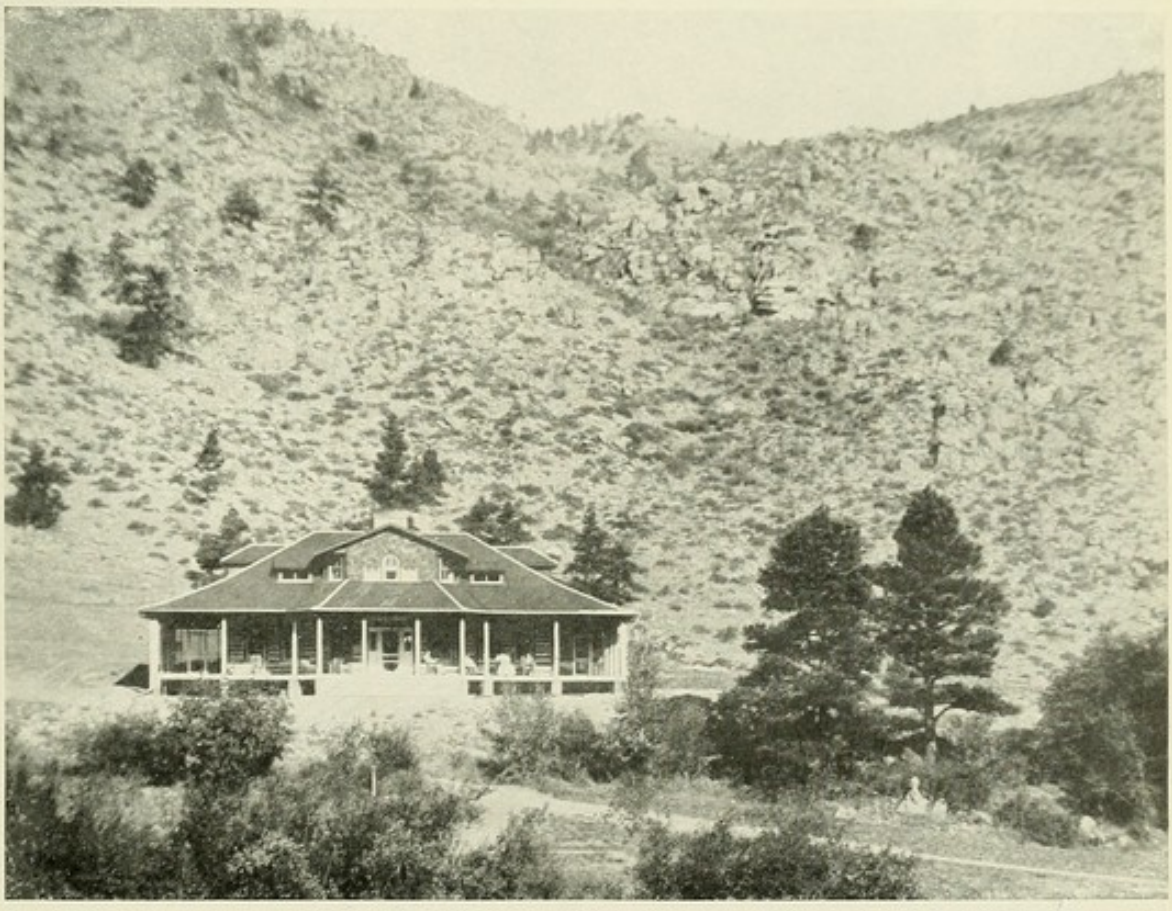


FIG. 2. ESTES PARK, COLORADO. IDEAL SUMMER RESIDENCE, WITH SPACIOUS PORCHES FOR PULMONARY INVALIDS. SLOPING GROUND, SANDY SOIL, MOUNTAINOUS BACK-GROUND AFFORDING PROTECTION FROM WIND AND DUST.
Courtesy of Dr. S. G. Bonney

SHARON SANATORIUM, MASSACHUSETTS. PATIENTS TAKING THE SUN BATH IN WINTER
Courtesy of Dr. Vincent Y. Bowditch

at night. Those given preference in treatment were patients whose dependents, circumstances, and health most demanded it. The new hospital and its location are picturesque as well as healthful, and patients are able to remain throughout the winter. The main building is 125 feet long and contains dining-room, kitchen, examination and rest rooms, and has a spacious veranda facing the south. It is designed to accommodate 150 patients, in the two pavilions, two cottages, and children's building. The Day Camp has proved to be a great success.

Day camps, when properly conducted, have an immense value on educational lines. In addition they remove for a time the sources of infection from the community and from the homes. These patients cannot always go to a sanatorium but in this way receive proper care during a large part of the day and may eventually avoid the necessity of going to a sanatorium; others who need sanatorium care are provided for, pending admission; and after discharge from the sanatorium the camp helps to complete the cure. Dr. Otis does not believe that these camps are destined to become a permanent therapeutic measure in conducting the cure.

The best location for day camps is in the forest. In Germany they are known as Walderholungstätte and there are over eighty of them scattered throughout the Empire. Those who are only slightly affected with tuberculosis, or are convalescent from it, pass the day in camp and return at night to their homes. The accompanying illustration (pl. 76) shows these camps for adults and children at Kuhfelde, Germany. These forest convalescent homes are greatly favored by the German insurance societies and sick lodges. Their benefits are extended to the children of patients.

Germany must be given credit for making the greatest discoveries and for instituting the most rational methods of treatment in connection with tuberculosis. The most thorough measures are adopted by the Imperial Government, the industrial insurance companies and by the medical profession of Germany.

According to the business report of the German Central Committee for the campaign against tuberculosis, there were in Germany in 1908 99 popular sanatoria for adults affected with disease of the lungs. These have 10,539 beds, 6,500 for men and 4,039 for women; in addition there are 36 private sanatoria with 2,175 beds, so that in all, 12,714 beds for adult tuberculosis patients are available. For children with pronounced tuberculosis there are 18 sanatoria with 875 beds; besides there are 73 institutions, with 6,348 beds, in which

are received only "scrofulous" children and those who are threatened with tuberculosis. During the last five years these facilities have been greatly increased; 31,022 insured persons were treated in the sanatoria during a total of 2,312,850 days of care, at a cost of 11,483,033 marks ($2,755,928). On an average, each person treated received 75 days of care at a cost of 370.16 marks ($88.84) or 4.96 marks ($1.19) per person for each day of care.

Night Camps.—These afford open air conditions of sleeping, either for patients with arrested tuberculosis who pursue their occupation by day in the nearby city, or with disease still unarrested but who are able, or from necessity are compelled to work by day.[1]

Sleeping porches and balconies.—Sleeping out of doors requires special arrangements which are not usually found in cities. The ordinary dwelling, apartment house, or tenement has no provision for this innovation in tuberculo-therapy. Suburban and country houses or those in the less crowded cities are better adapted for the conversion of an upper porch or balcony into a sleeping apartment. In Denver, for instance, the practice is common enough to excite little comment. Detached houses are usually easily fitted with the necessary screened enclosures.[2]

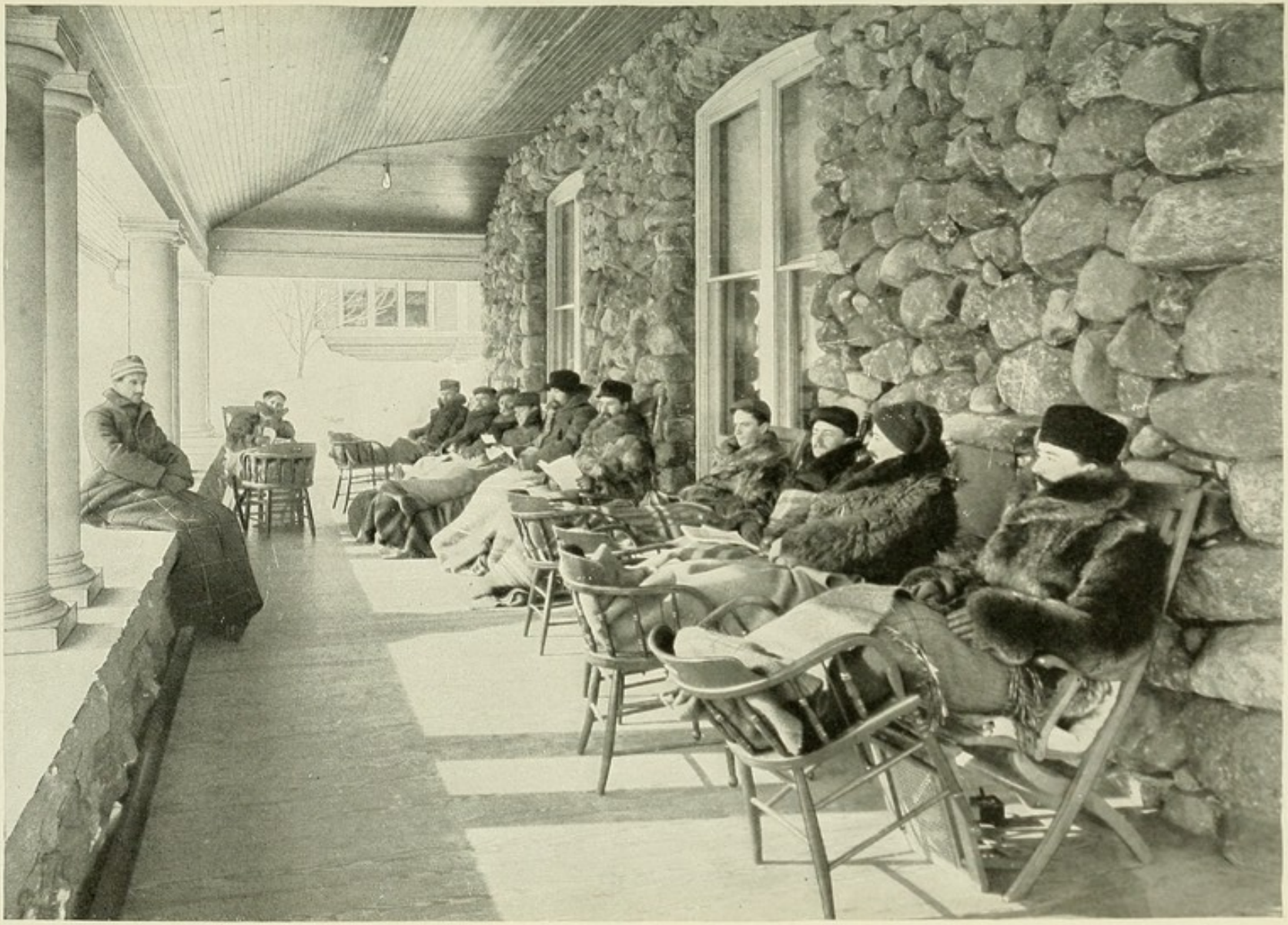
Pavilions are more substantial and permanent than the forms of shelter previously referred to. Where large numbers of patients must be cared for at a minimum of expense the pavilion system has distinct advantages, especially for night use. At the Metropolitan Hospital, Blackwell's Island, New York City, about one-third of all consumptives under hospital care in New York are there provided for in the tent pavilions referred to on page 123; these tent pavilions cost about $12.00 per bed or $144.00 for a tent pavilion with a capacity of 12 beds.

At the Manhattan State Hospital for the Insane, Ward's Island, New York, more substantial and permanent pavilions have been constructed of wood and glass and have displaced the cloth tents. These pavilions are heated by steam, lighted by electricity, and have removable glass sides permitting a free circulation of air and light all the time. Their per capita cost is about $100.

In addition, there are camps for both the men and the women with a total capacity of 175 patients. In summer some canvas tents

[1] E. O. Otis: Institutions for the Prevention and Cure of Tuberculosis, Boston Med. and Surg. Journ., Aug. 1, 1912.

[2] See "Directions for Living and Sleeping in the Open Air," National Ass. Tuberculosis, 1910. See T. S. Carrington: Interstate Med. Journ., April, 1914.



OPEN AIR LIFE AT THE ADIRONDACK COTTAGE SANITARIUM; WINTER

SANATORIUM ST. BLASIEN IN THE BADEN BLACK FOREST. THIS "REST HALL" IS CLOSE TO THE WOODS, HAS A PERMANENT ROOF AND FLOOR AND AWNINGS WHICH ARE ROLLED UP OUT OF SIGHT

Courtesy of Dr. A. Sander

FIG. 1. DAY CAMP FOR TUBERCULOSIS PATIENTS, HOUSE OF THE GOOD SAMARITAN, BOSTON

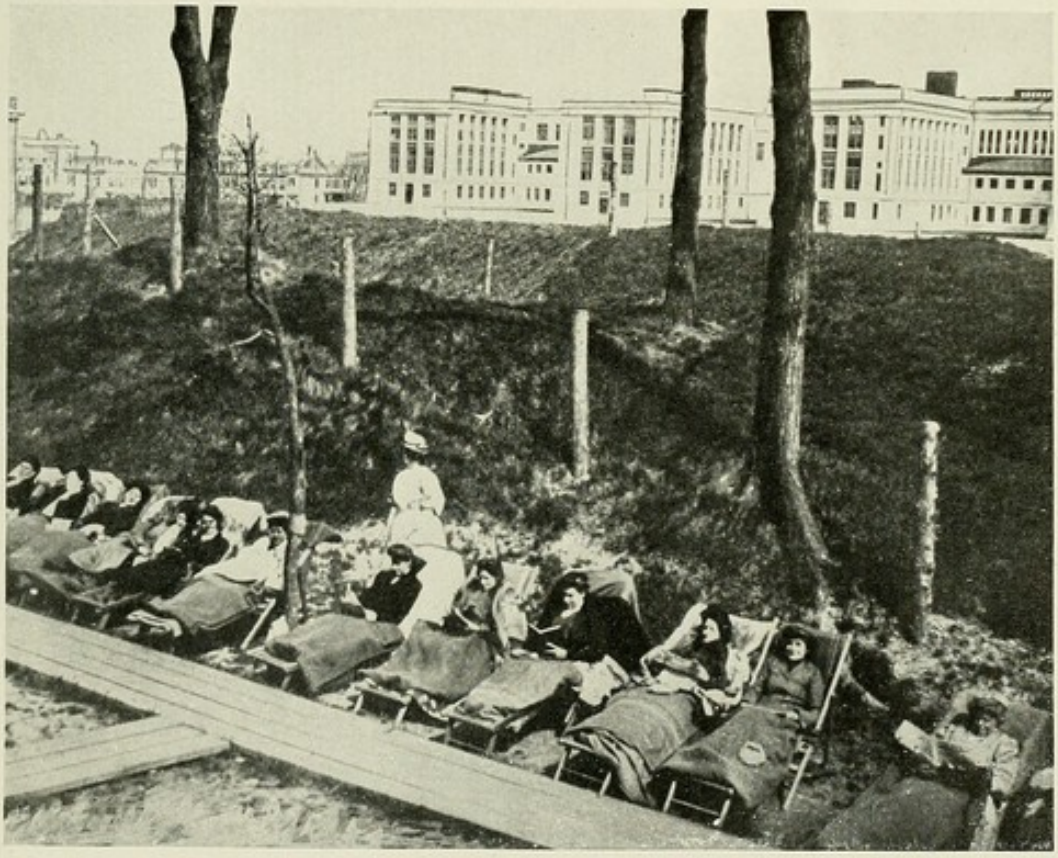
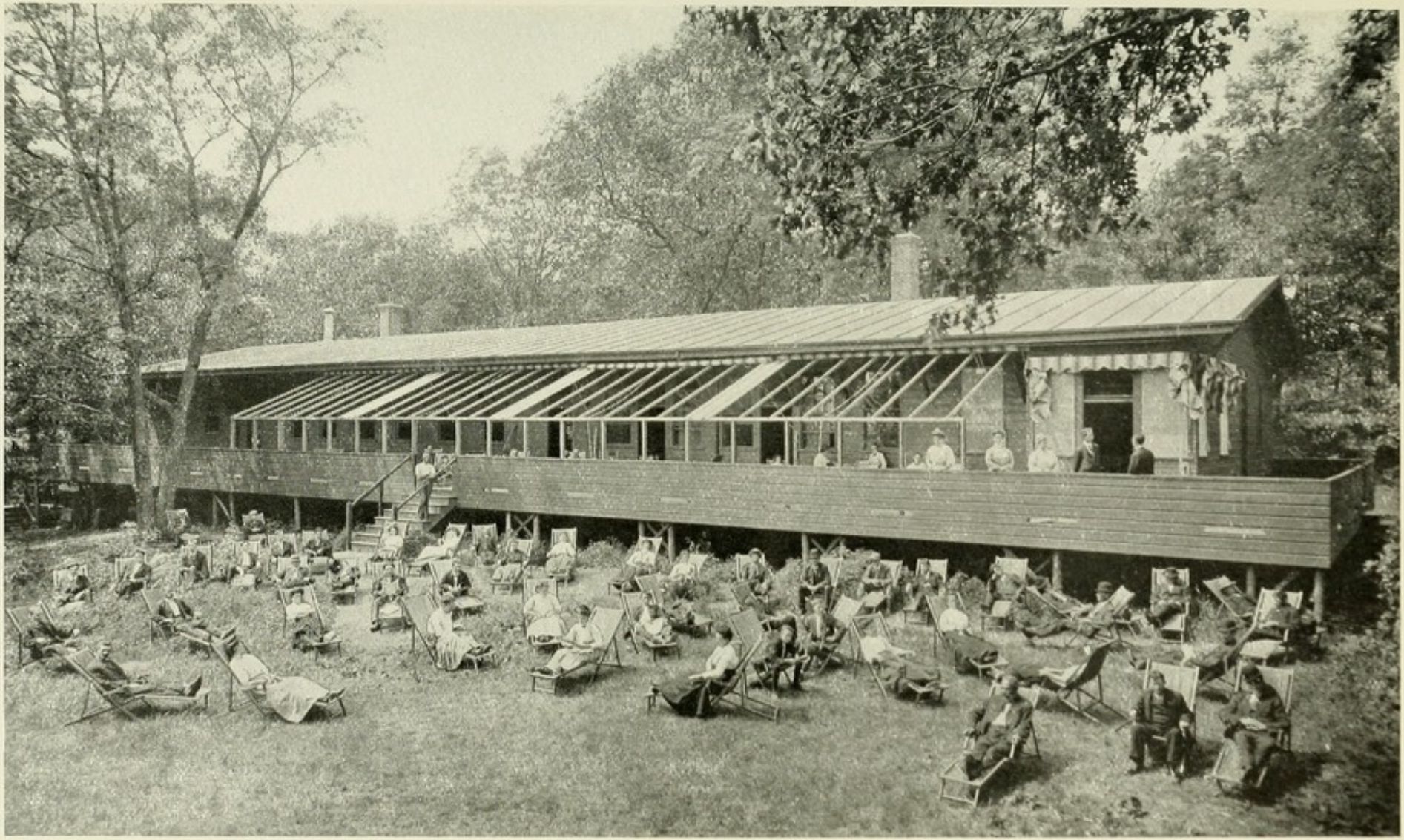


FIG. 2. A DAY CAMP FOR TUBERCULOUS PATIENTS AT THE HOUSE OF THE GOOD SAMARITAN, BOSTON, NEAR THE HARVARD MEDICAL SCHOOL

DAY CAMP FOR TUBERCULOUS PATIENTS, HOLYOKE MASSACHUSETTS



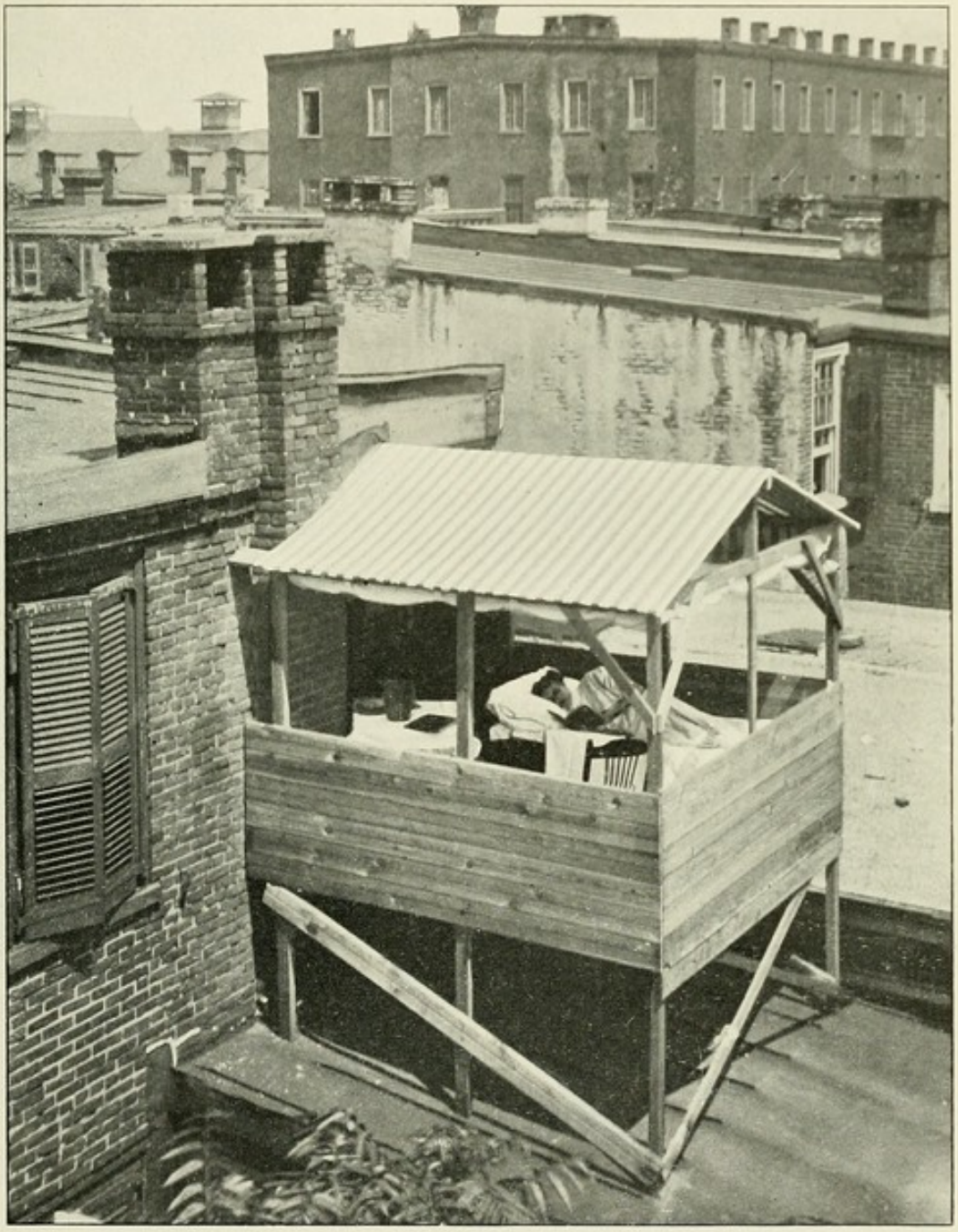
BOSTON CONSUMPTIVES' HOSPITAL AT MATTAPAN. DAY CAMP. PATIENTS REPORT AT 9 A. M. AND RETURN HOME BETWEEN 5 AND 6 P. M.

BOSTON CONSUMPTIVES' HOSPITAL AT MATTAPAN. COTTAGE WARD; LENGTH 150 FEET; CAPACITY 26 BEDS. IT AFFORDS CARE AT NIGHT FOR AMBULATORY CASES

DOECKER PORTABLE BARRACKS, USED AS A RECOVERY STATION, AT KUHFELDE IN THE ALTMARK, GERMANY
Courtesy of Christoph and Unmack

FIG. 1 DIET KITCHEN. DAY CAMP AT PARKER HILL, BOSTON, MASSACHUSETTS

FIG. 2. SLEEPING BALCONY USED BY A PATIENT IN HAVERHILL, MASSACHUSETTS



SLEEPING PORCH IN A CROWDED DISTRICT OF PHILADELPHIA

DOUBLE SLEEPING PORCH WITH EASTERN AND SOUTHERN EXPOSURES. THIS SUMMER RESIDENCE IN ESTES PARK, COLORADO, IS PROVIDED WITH PORCHES ON ALL SIDES SAVE THE NORTH, WHICH IS PROTECTED BY THE ROCKY FORMATION IN THE BACKGROUND. THE PORCH IS COVERED WITH A PERMANENT ROOF.

Courtesy of Dr. S. G. Bonney

CITY RESIDENCE WITH IDEAL UPPER DOUBLE SLEEPING PORCH CONNECTED WITH BEDROOM. SHEATHING AT THE BASE, WIRE SCREENING, AWNINGS, ELECTRIC LIGHT.

Courtesy of Dr. S. G. Bonney, Denver

PAVILIONS AT THE ROYAL VICTORIA HOSPITAL FOR CONSUMPTION, EDINBURGH, SCOTLAND
Courtesy of Sir Robert Philip

CANTON, MASSACHUSETTS, STATE HOSPITAL SCHOOL FOR CRIPPLED (TUBERCULOUS) CHILDREN, SHOWING UNIT

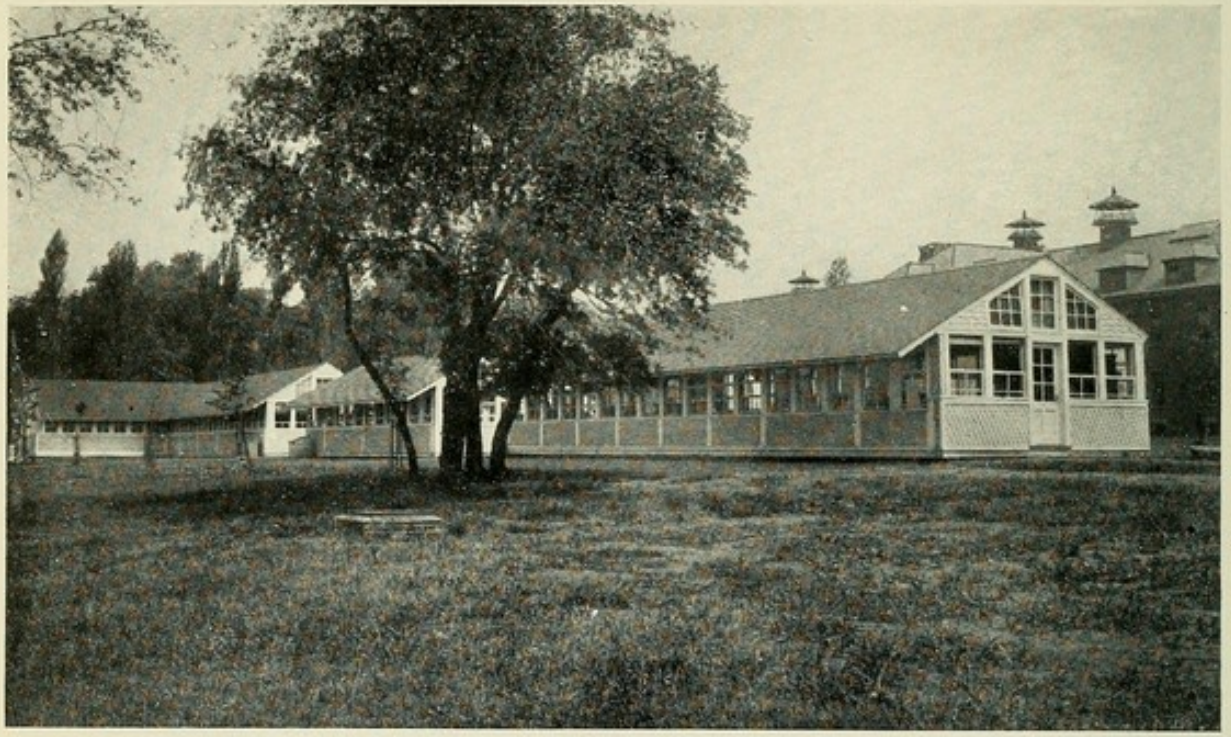


FIG. 1. MANHATTAN STATE HOSPITAL, EAST, WARD'S ISLAND, NEW YORK CITY. NEW PAVILIONS FOR THE TUBERCULOUS INSANE.
Courtesy of Dr. William Mabon

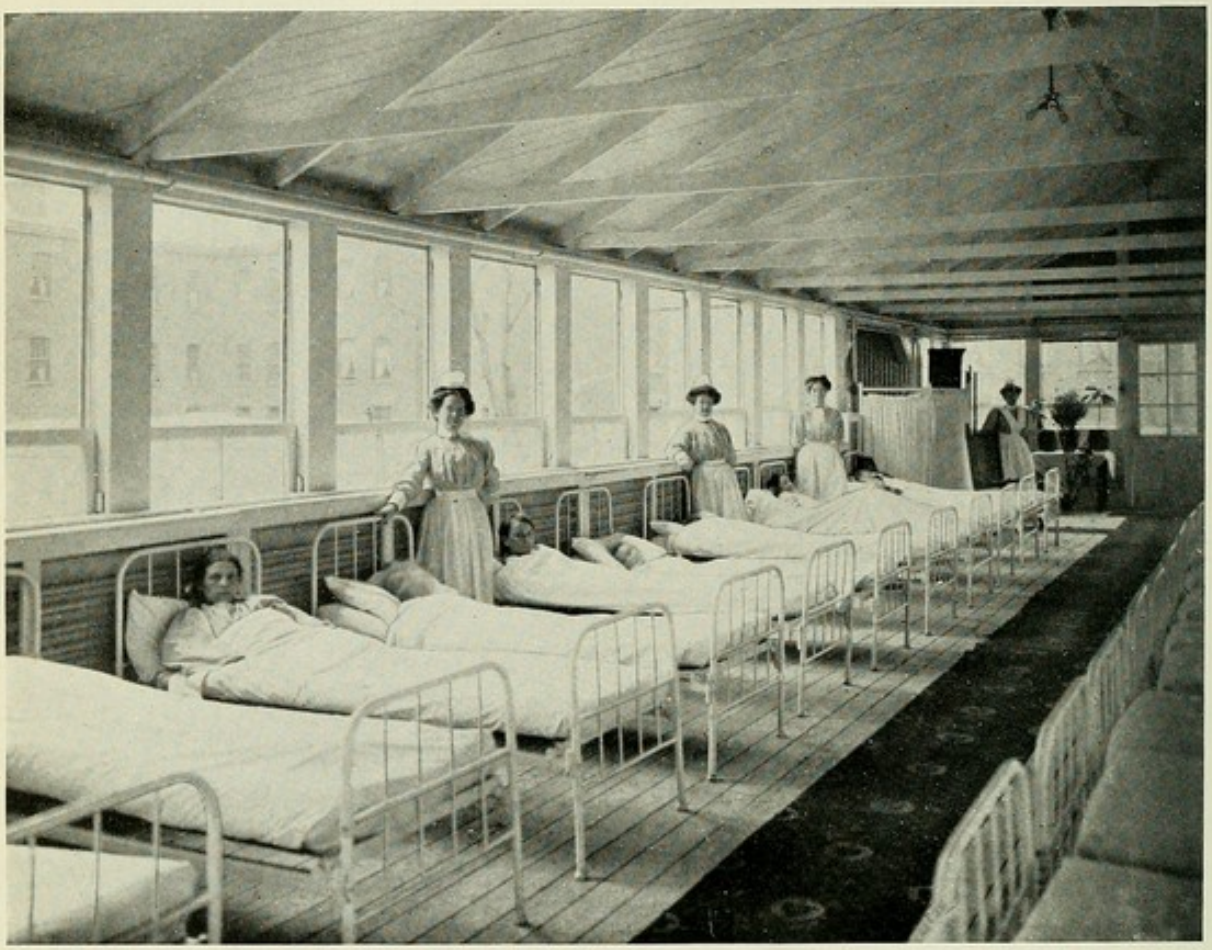


FIG. 2. MANHATTAN STATE HOSPITAL, EAST, WARD'S ISLAND, NEW YORK CITY. NEW GLASS PAVILION FOR THE TUBERCULOUS INSANE. WINTER
Courtesy of Dr William Mabon

INTERIOR OF ONE OF THE PAVILIONS, ROYAL VICTORIA HOSPITAL, EDINBURGH

Courtesy of Sir Robert Philip

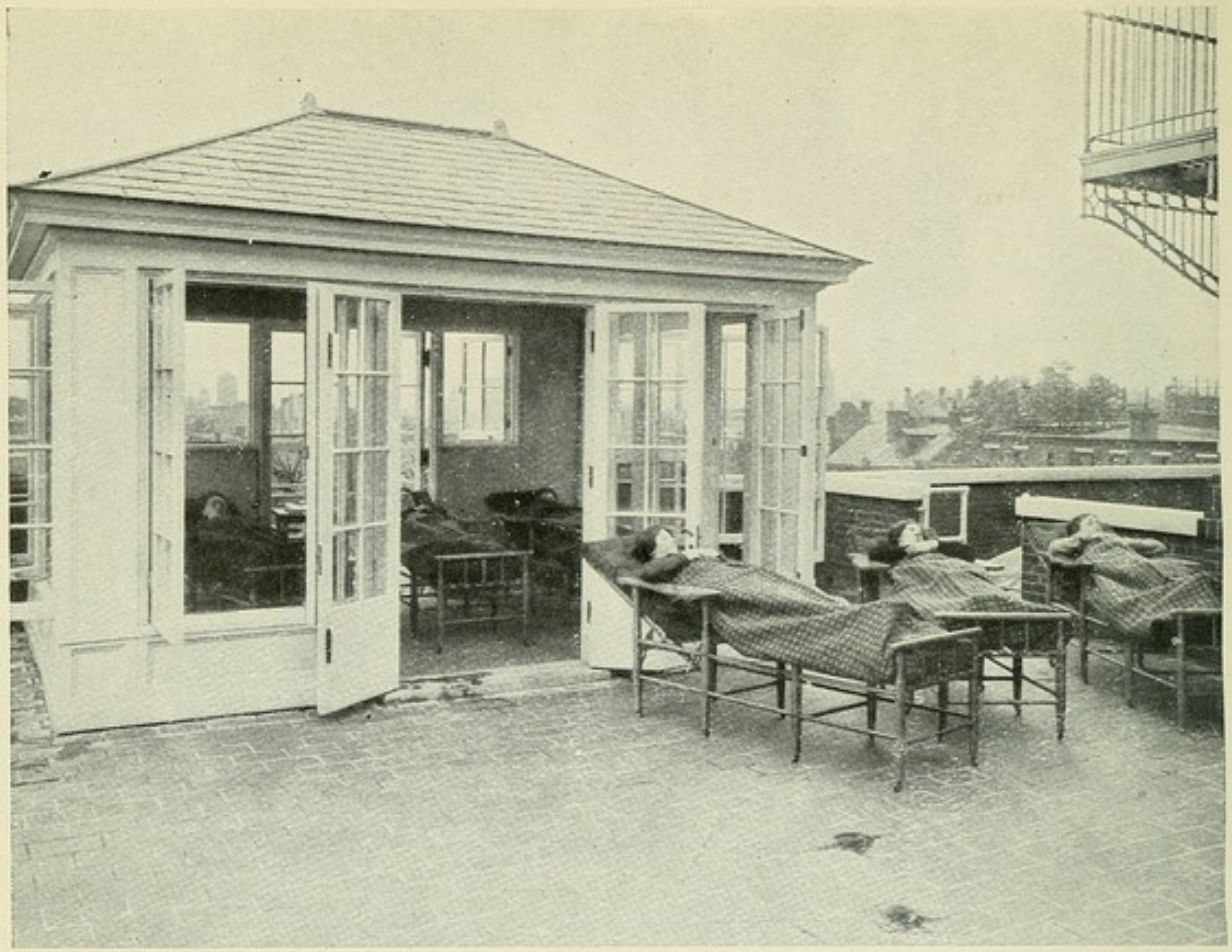


FIG. 1. KIOSK AND OPEN DECK ADJOINING WARDS FOR EARLY CASES OF TUBERCULOSIS PHIPPS INSTITUTE, IN A VERY OLD AND CROWDED PART OF PHILADELPHIA

Courtesy of Dr. C. J. Hatfield, Director

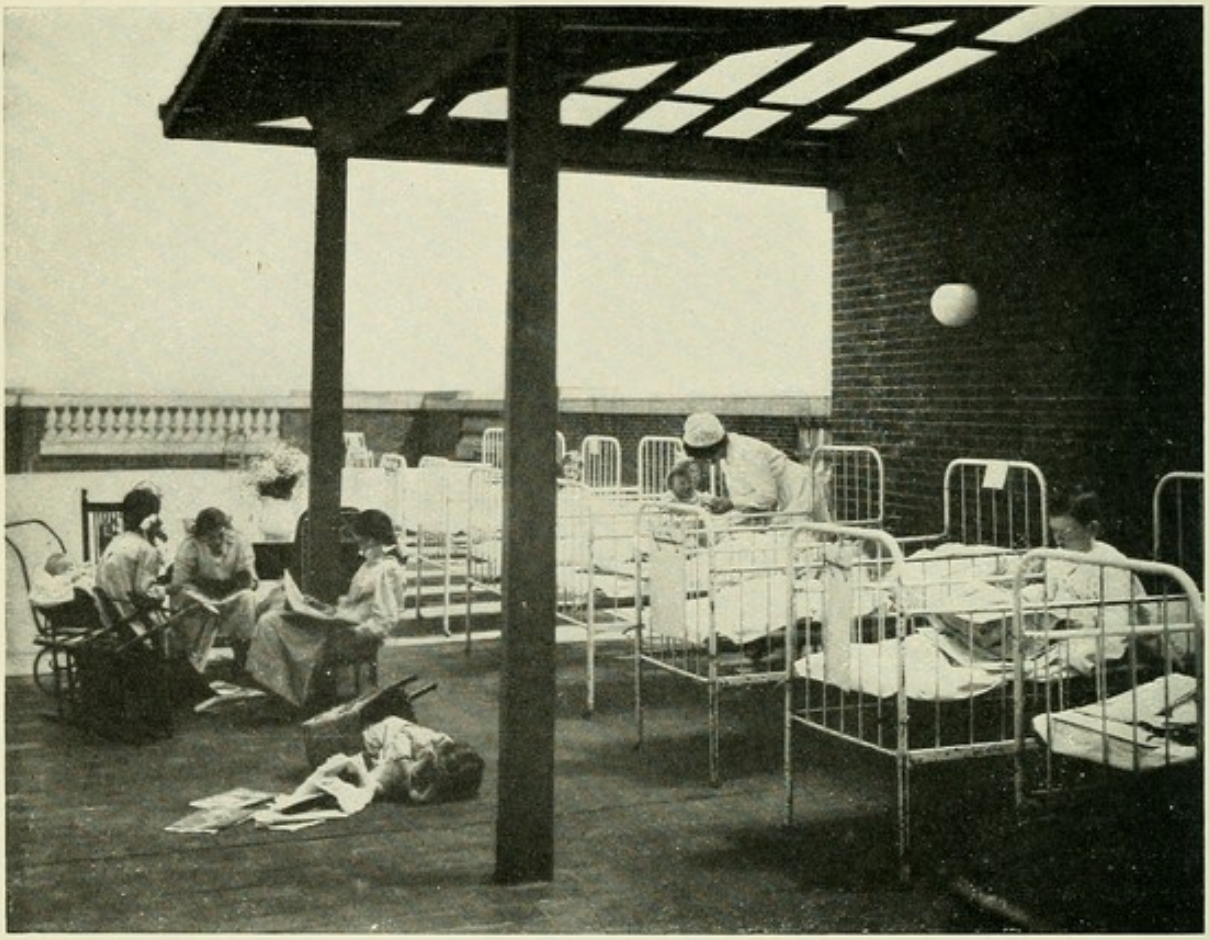


FIG. 2. BELLEVUE HOSPITAL, NEW YORK CITY. ROOF WARD FOR CHILDREN

Courtesy of Dr. J. W. Brannan

are used. The accompanying photograph (pl. 83), kindly furnished by Dr. Wm. Mabon, the superintendent, shows the character of the pavilion.

In the Royal Victoria Hospital for Consumptives, Edinburgh, Scotland, still more substantial and expensive pavilions are in use as seen from the illustrations (pl. 84) kindly furnished by Dr. R. W. Philip.

Roof Gardens.—At the Philadelphia Hospital the first attempt to segregate tuberculous patients for the fresh air cure was by means of a roof garden ward. This was a vast improvement over the previous method of indoor confinement and was greatly appreciated by the patients. The roof garden ward was in use winter and summer, but later gave way to the six glass pavilions erected at an expense of over $112,000.

Each pavilion is intended to accommodate eighteen patients, usually in an advanced stage of tuberculosis. Each is separate in itself with walls and roof of glass and only sufficient metal work to give proper support. The floors are of cement so as to be as smooth and non-absorbent as possible. Including the porches, which are also enclosed in glass, each pavilion measures 39 by 70 feet. The glass is arranged in frames in both walls and porches and by means of automatic devices one side of the building or all three sides may be thrown open. Screens or shades are arranged to prevent too much access of the sun. The system of ventilation and heating is considered ample.

Detached Cottages.—At the Nordrach Ranch Sanatorium, three miles from Colorado Springs, independent cottages resembling tents are used. These are economical and insure privacy and sufficient protection. The system is adopted from that in use in Nordrach, Germany.

The highest development of housing for the tuberculous patient is undoubtedly the independent cottage. It is necessarily expensive, but the patient fortunate enough to be its inmate has a maximum of comfort and at the same time is in the enjoyment of the best atmospheric conditions night and day. At the Loomis Sanatorium where the snow lies on the ground more than four months in the year, and at Saranac Lake, in the Adirondack Mountains, where the winters are even longer and more severe, the independent cottage is a distinctive feature.

Sleeping Canopies.—Detachable windows may be applied to tents, pavilions, or ordinary dwellings, so as to allow patients to breathe

by day and night the outer air uncontaminated by others occupying the same room or dwelling. Devices suitable for any window may be obtained. It is thus possible in a hospital ward to have half a dozen patients breathe the outer air while the ward is kept warm. The tent can come over the end of the regular hospital bed so that patients sleeping in wards where miscellaneous cases are received, may nevertheless have the full benefit of the outer air. By means of thick celluloid the patient may be readily seen. The celluloid window may be raised to give the patient drink and nourishment.

Plate 93 shows the Walsh Window Tent applied to the window of an ordinary dwelling.[1]

CHAPTER X. CONCLUSIONS.

There are some people, especially those of a skeptical or combative tendency, who refuse to admit that climate plays any important rôle in the cure of tuberculosis. One of these who was formerly in charge of a widely known institution for the study and treatment of tuberculosis has said: "I desire to go on record as believing that there is no therapeutic value in climate." This same physician probably owes his life to the fact that thirty-five years or more ago he left the city and removed to the mountains of Pennsylvania for the relief of a pulmonary disease and recovered. Such an attitude is a study for the psychologists and would hardly seem deserving of serious attention, except that we hear such statements as this: "If a case of consumption cannot be cured in its home climate it cannot be cured anywhere."

I think there is no doubt that if any of us were told that he is in the incipient stage of tuberculosis he would immediately take steps to familiarize himself with the line of treatment which would, before much time had elasped, involve leaving Boston, New York, Philadelphia, or Chicago, as the case might be, and so live as to enjoy what air and sunshine and other atmospheric features might afford.

One reason why home climates, if such a term may be permissible, have grown in favor is that it has been found necessary to establish a large number of State sanatoria, or at least to seek aid for private sanatoria from some of our State legislatures. It is a matter of expediency to have such sanatoria and legislators must be convinced that good results or, if necessary, the best results, can be obtained close at hand. We are all heartily in favor of such institu-

[1] For the history of this tent see Knopf and McLaughlin, N. Y. Med. Journ., 1905, Vol. 81, 425.

tions whether or not we should wish to stake our chances of recovery in any of them.

Of course we do not claim that there is any specific climate for tuberculosis and the long search for such climate, a search lasting for nearly two thousand years, is apparently at an end.

Now what is there left to us, and what do we understand by a climatic change?

We all know that the New England climate is changeable, that is, the meteorological conditions are constantly varying just as they also vary in the Mississippi Valley and along the Atlantic seaboard. But the New England climate is peculiarly unstable and, as Charles Dudley Warner has said, "New England is the battle-ground of the weather."

We have a change of climate when we leave the hot city in summer and go a few miles to the shore. We have floating hospitals so that this climatic change may stimulate a sick child to recovery. A so-called "home-climate" may work a cure or aid in a cure because we leave the climate of our homes, often too dry with furnace heat, too poorly ventilated, too damp from lack of sun, and remove to more hygienic dwellings in the same locality where sun and air and cleanliness abound.

But, to take up the principal question at issue, the first thing usually asked is whether one should go to the Adirondacks, Colorado, New Mexico, Arizona, California, or elsewhere, in order to get what is so frequently claimed to be the greatest climatic advantages. No one who has visited these localities can fail to be impressed with the living examples of recovery from tuberculosis. Denver, Colorado Springs, and innumerable towns in southern California abound in doctors who have practically recovered from this disease and are earning a living that is the envy of their eastern confrères.

Would they have recovered in their eastern homes? Almost to a man they answer "No." I have never heard of an exception. But the case is hard to prove from such *ex parte* evidence. However, it is interesting to note Dr. H. B. Dunham's conclusion. He stated in 1904, after visiting discharged Massachusetts State Sanatorium patients in the west, and after comparing Massachusetts Sanatorium statistics with those of the U. S. Army Sanatorium at Fort Bayard, New Mexico, that "the results corroborate our beliefs in the efficacy of residence in dry climates, but with a smaller margin in its favor than was anticipated." The proportion of people adapted for treatment in these extremes of climate must be more equal than

thought possible by climatologists generally. That is to say, a small majority of the patients at Rutland, Mass., would probably do better at Fort Bayard, New Mexico, and a large minority might do better at Rutland. But no one can say positively, in any given case, what would have been the outcome had he chosen differently.

We need not discuss the bearing of what to do for the poor or what to do for the rich, or the question of food, or the physician's management; these are important and may govern the choice, but what we want is an answer to the abstract question of the influence of climate.

We believe that climate may be *utilized as an adjuvant* of great value for carrying out the hygienic, dietetic treatment of all forms of tuberculosis and of many other diseases. There are some elements of climate that have a more positive influence in hastening cure than others. The first place must be assigned to an abundance of air, which is as nearly as possible bacteriologically and chemically pure. It goes without saying that city air is polluted by smoke and dust and all dwellings, whether in the city or the country, are far below the standard of purity desirable. Only on the sea or at the highest elevations do we find air really pure, but we can approximate it by living out of doors. There is a climate of the city, a suburban climate, a climate of the country, woods, and plains, all differing as regards purity of air. We are all probably agreed on this point.

Next comes the subject of sunshine. We admit that good results are obtained in cloudy regions as, for instance, in the Adirondacks and at Rutland; but there is at least no objection to sunshine, and I believe that the moral effect of bright sunny days and plenty of them is very great. Invalids always welcome the sun. We can protect ourselves from too much sun if need be, and I, for one, believe that sunlight does a vast amount of good and sunny regions are much to be preferred, other things being equal. That is the great asset of our western plains and mountains; and it is a real asset that counts. Of course there are exceptions. Tastes differ. Dr. Solly used to relate the story of one of his countrymen who had been sojourning in Colorado and finally returned to England. As he landed in a fog and found himself home again, he exclaimed, "Thank God! I am out of that beastly sunshine." I do not suppose he intended to be irrational or ungrateful for the greatest of all natural gifts.

Now, what other climatic conditions besides pure air and abundant sunshine have we to help us? Is a cool climate or a warm climate the best? Is a dry or humid climate to be preferred? These quali-

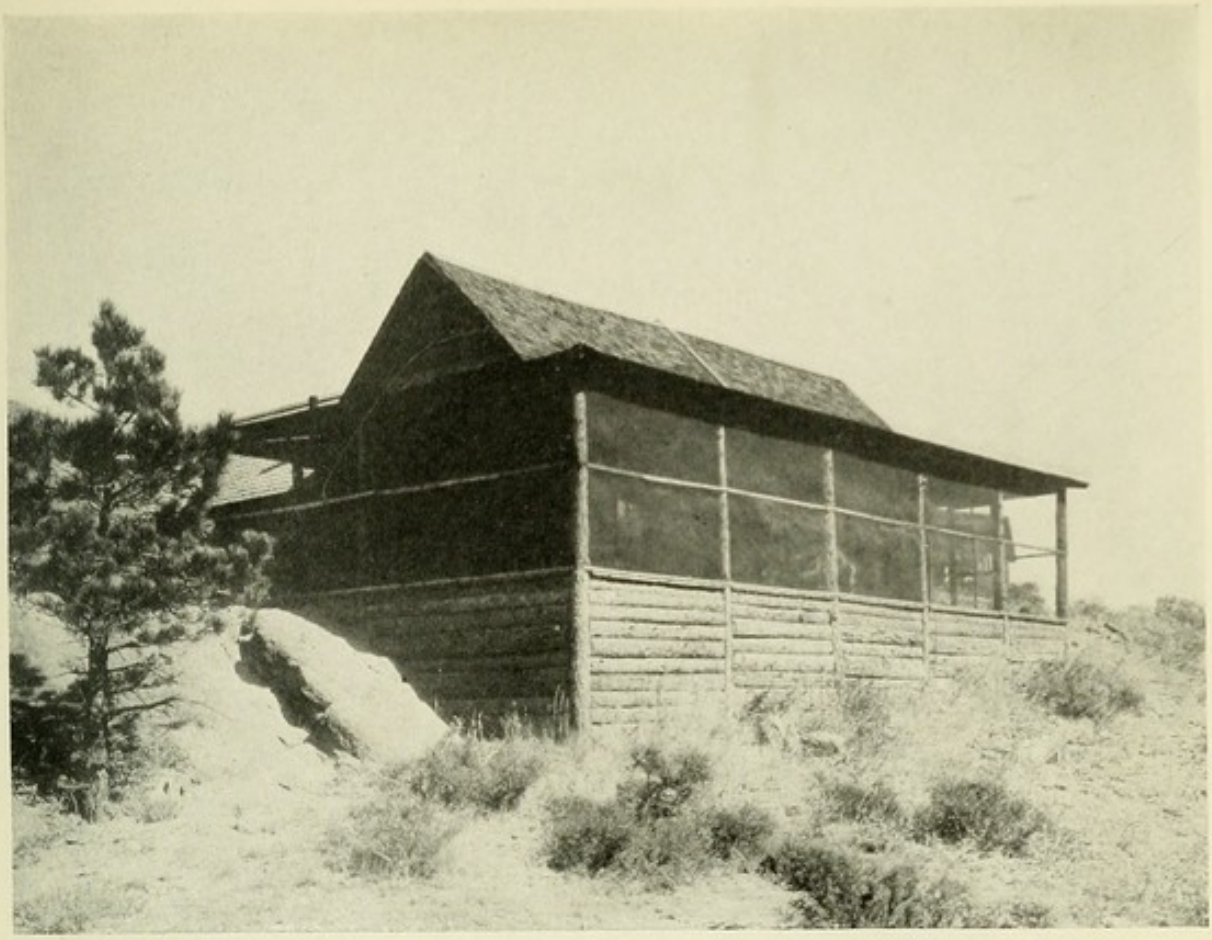


FIG. 1. SHACK WITH SCREENED PORCH. ESTES PARK, COLORADO
Courtesy of Dr. S. G. Bonney

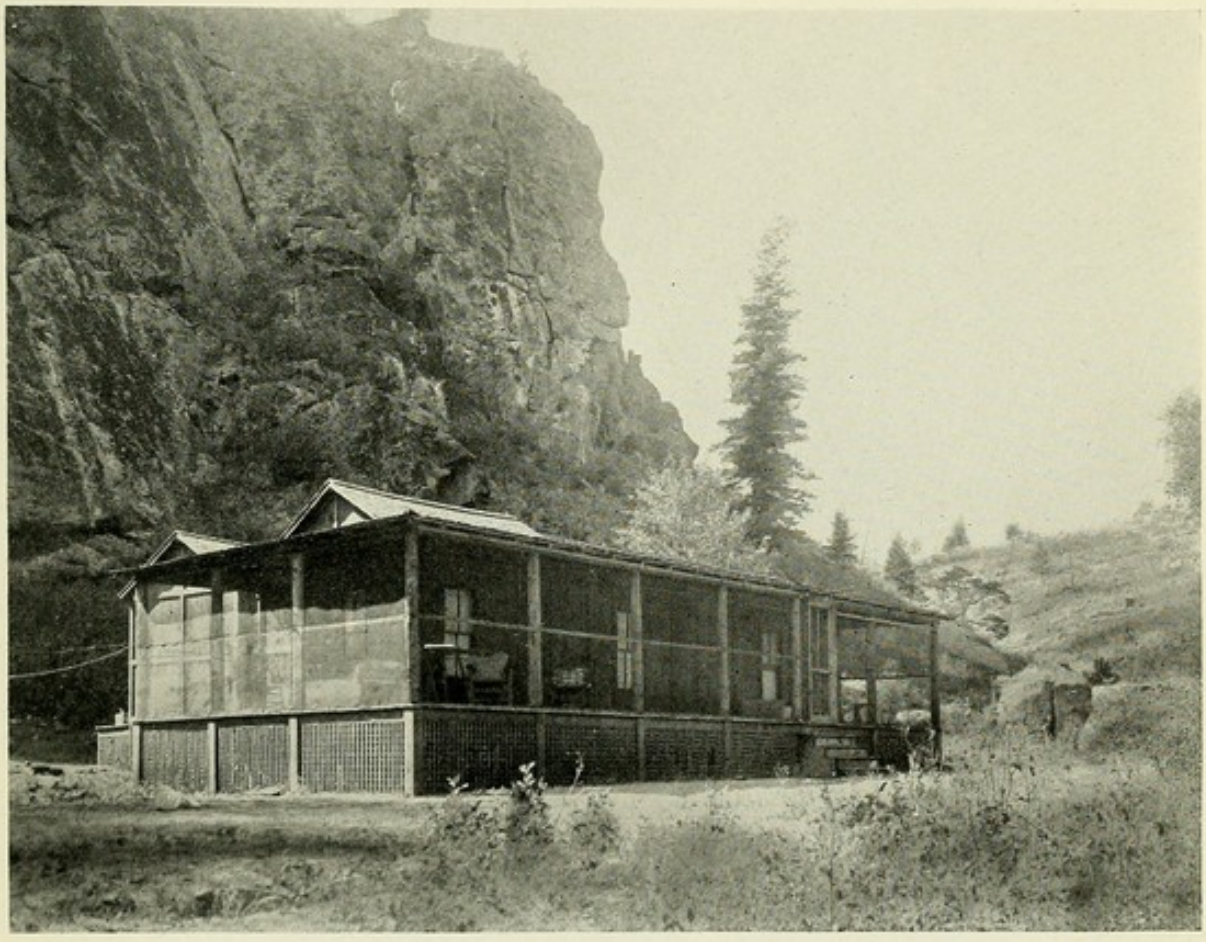


FIG. 2. WELCH'S RESORT, FIVE MILES FROM LYONS, COLORADO. SIX ROOM COTTAGE SOMEWHAT PRIMITIVE BUT WITH AMPLE SCREENED PORCH. SHELTERED FROM NORTH AND WEST WINDS.

Courtesy of Dr. S. G. Bonney

VIEW OF THE ROCKY MOUNTAIN RANGE FROM THE PORCHES OF SUMMER COTTAGES, ESTES PARK, COLORADO
Courtesy of Dr. S. G. Bonney

COTTAGE AT THE ADIRONDACK COTTAGE SANITARIUM, NEW YORK

FIG. 1. ANNE M. LOOMIS MEMORIAL COTTAGE—(NEW INDEPENDENT UNIT) LOOMIS SANATORIUM SULLIVAN COUNTY, NEW YORK

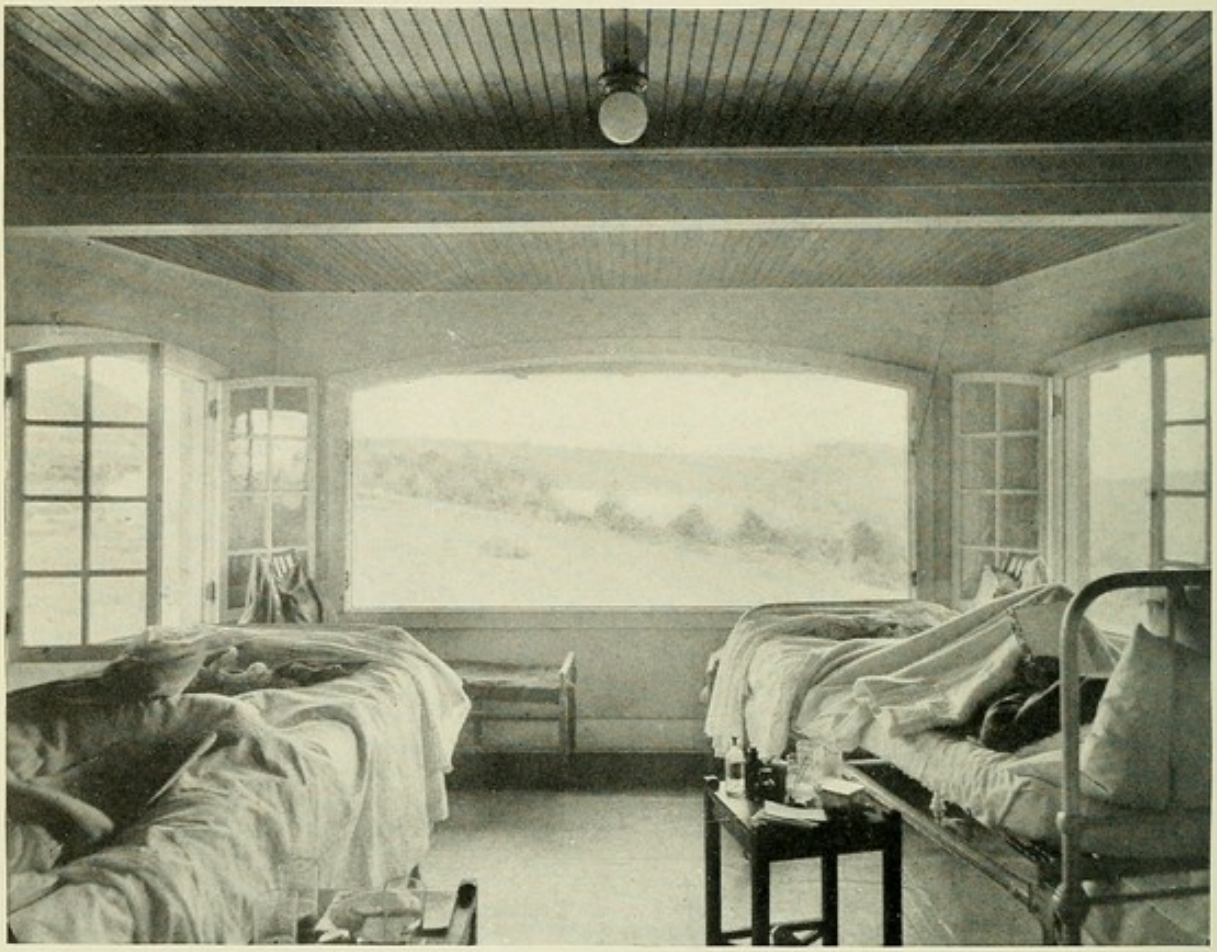


FIG. 2. LOOMIS SANATORIUM, SULLIVAN COUNTY, NEW YORK. ONE OF THE EAST PORCHES OF THE MARY LEWIS RECEPTION HOSPITAL

ties of temperature and humidity may as well be considered together. Undoubtedly for the majority of cases in the first stage the climate should be dry and the temperature comfortable—not warm enough to be relaxing, but not so cold as to be repellent and restrict exercise or out-of-door life. It is true that in special localities better results are obtained during the cold months than during the summer. This is true of the Adirondack Cottage Sanitarium in the State of New York. One reason for this is that in winter the lakes and ponds are frozen and covered with dry snow; the air is drier. It is far enough north and at a sufficient altitude to escape the alternate freezing and thawing that is experienced in New York City, where unquestionably it is less favorable for the consumptive during the cold season than during the warm months. Take Florida and South Carolina: Undoubtedly the best season there is during the winter months, as the summers are oppressively warm and wet. The winter is the dry season and the temperature is comfortable. The interior of Florida forty or fifty miles from either coast is reasonably dry. As far as Arizona and New Mexico are concerned, the summers are too hot at all the lower elevations for any invalid, but at the higher elevations, 5,000 or 6,000 or 7,000 feet, the summer heat is not oppressive. Along the southern coast of California and at many of the resorts somewhat inland, as good results are obtained in summer as in winter, although the latter is the more fashionable season for eastern visitors. The southern California resorts which have been most frequented by consumptives vary greatly between themselves as regards the important question of humidity. That a place is frequented by consumptives does not prove that it is a desirable place for them. Many of them are misguided, wandering invalids, sent out from the east with little or no judgment as to their individual needs and with no proper knowledge on the part of their medical advisers as to the humidity or local character of the places to which they are destined. A man, for instance, will go to Los Angeles. It does not take him long to find out that while the air is fairly dry from 11 a. m. to 5 p. m., it is always damp at night. Six hours out of twenty-four are dry, the remaining eighteen are decidedly damp. The physicians of Los Angeles do not claim that their climate is a suitable one for cases of tuberculosis and usually send these cases to the interior stations, such as Redlands or Riverside, Monrovia or Altadena. Many are sent to Arizona. Experience shows that consumptives do better if they avoid the coast region. Or, if near the coast, as at Santa Barbara, they are better if they

find a site at some elevation on the hillside or in the mountain valleys beyond the reach of the morning fog and the excessive humidity at the shore.[1] The records of the Weather Bureau show that these places on the coast or within reach of the fogs which penetrate inland have a greater humidity than Boston or New York, the mean annual absolute humidity for Santa Barbara, Los Angeles, and San Diego being given at 4.20, 4.42 and 4.34 grains, more than one-third more than that of New York and Boston, 3.19 grains and 2.84 grains. The mean annual relative humidity of all these places mentioned is from 72 to 73 per cent. But the advantage of places like Santa Barbara, San Diego, Redlands, and Riverside, lies in the fact that the mean annual humidity shows a remarkable variation during the twenty-four hours compared with places like Boston, New York, or Philadelphia, where the daily range is much less. At Redlands, fifty miles inland from the Pacific Ocean, one of the best known stations, the hygrometer has been known to indicate in fair weather 55 per cent at 4.30 p. m., and 80 per cent at 6.00 p. m. The relative humidity is sometimes as low as 30 per cent for a limited time during the day, and 70 to 80 per cent at night when the temperature is from 44° to 60° F.

It may as well be stated that the government records of humidity are quite misleading when we use them to judge of the climate of any given place. The observations are made at 8 a. m. and 8 p. m., but in the invalid's day, made up of the intervening hours, the relative humidity reaches a much lower mark than the records show. I often observe a relative humidity in Virginia of 25 or 30 per cent at 2 p. m., and 95 or 98 per cent at night or in the early morning, especially when dew falls after a bright, invigorating day. I think that people, whether sick or well, adjust themselves to these natural changes of humidity if properly clothed and constantly in the open air; but when subject to rapid changes in humidity, as in going back and forth from the excessively dry air of a house in winter to the damp air outside, the demands upon the mucous membranes are very great and such frequent and violent changes certainly do harm to susceptible people. Such rapid variations or alterations of the humidity of the inspired air I think are as bad as would be rapid alternations of altitude involving variations of several thousand feet.

Some patients, however, seem to do better with a humidity greater than that chosen for others. If we have a low relative humidity

[1] See W. Jarvis Barlow, M. D.: Climate in the Treatment of Pulmonary Tuberculosis (Journ. Amer. Medical Association, October 28, 1911).

and at the same time a moderately low temperature the general effect is tonic and it is beneficial in conditions of irritability of the respiratory mucous membrane; but if the temperature is very low this may be rather irritating. We find atmospheric conditions like this from Minnesota to the Rockies and through Manitoba and Alberta.

The combination of high relative humidity and low temperature certainly favors catarrh and we have such conditions all winter long in the region of the Great Lakes and in New York and New England. Probably the best combination is a low humidity and a moderately cool temperature; the average tuberculous patient makes his best gains after August first and in subsequent cold, dry weather when such conditions prevail. But of course there are exceptions and some do better with a high relative humidity and a warm temperature; these are not numerous and probably include more of the patients in later stages when expectoration is profuse and vitality is low.

The old idea about equability of temperature, at least between the temperature of midday and midnight, is not of great importance; all mountainous stations show great variations in this respect. Some variability tends to stimulate the vital activities, but in older people and those who are feeble great variability is a disadvantage.

As far as altitude is concerned it probably has not, *per se,* any great influence; certainly to my mind not so much as we used to think. However, altitude is incidentally associated with mountain life or life on the plains, with more sun, less moisture, and scattered population. We should not forget that surgical tuberculosis is always favorably influenced by a seashore residence suitably chosen.

I never shall forget the wonderful impression made on visiting the Sea Breeze Hospital for Tuberculous Children on Long Island, New York. Constant outdoor life in all weather works miraculous cures after the most formidable operations for bone tuberculosis and in many cases renders them wholly unnecessary in patients whose physical condition on admission was most unpromising. All the great French and Italian sanatoria for tuberculous children are located on the seashore.

Among the numberless histories of the climatic cure I will give only one and I think I may safely let it stand as a good example by which to let the argument rest. The history is that of a physician whom we all love and respect. It was published, together with twenty other carefully recorded histories, by that prince of clinicians,

the late Dr. Alfred L. Loomis, in the Medical Record and formed a part of a paper read before the Medical Society of the State of New York in 1879, a paper which we commend to your attention. Dr. Loomis says:

At the age of twenty-five this patient, being of good family history, began to lose his health in the winter of 1872. His symptoms were rapidly becoming urgent; he was examined by several physicians. Extensive consolidation at the left apex was found, extending posteriorly nearly to the angle of the scapula; on the right side nothing was discovered save slight pleuritic adhesions at the apex.

He was ordered south, but returned in the spring in no way benefited. On the contrary, night-sweating had set in, and his fever was higher. In the latter part of May he started for the Adirondacks, the ride in the stage being accomplished on an improvised bed. His condition at this time was most unpromising; he had daily fever, night sweats, profuse and purulent expectoration, had lost his appetite and was obliged constantly to have recourse to stimulants. Weight about 134 pounds. He began to improve at once, his appetite returned, all his symptoms decreased in severity, and after a stay of more than three months he returned to New York weighing 146 pounds, with only slight morning cough, presenting the appearance of a man in good health. A few days after his arrival in New York he had a chill, all his old symptoms returned and he was advised to leave for St. Paul, Minnesota, where he spent the entire winter. He did badly there; was sick the greater portion of the winter. In the spring of 1873 he again went to the Adirondacks. At this time he was in a most debilitated state, was anemic, emaciated, had daily hectic fever, constant cough, and profuse purulent expectoration.

The marked improvement did not commence at once as it did the previous summer, and the first of September found him in a wretched condition. I then examined him for the first time and found complete consolidation of the left lung over the scapula and suprascapular space, with pleuritic thickenings and adhesions over the infraclavicular space. On coughing, bronchial rales of large and small size were heard over the consolidated portion of the lung. Over the right infraclavicular region the respiratory murmur was feeble, and on full inspiration pleuritic friction sounds were heard. I advised him to remain at St. Regis Lake during the winter, and although he was repeatedly warned that such a step would prove fatal, he followed my advice.

From this time he began slowly to improve. Since that time he has lived in this region. At the present time his weight is 158 pounds, gain of 22 pounds since he first went to the Adirondacks in 1873, and ten pounds more than was his weight in health. He has slight morning cough and expectoration, his pulse is from 72 to 85 and he presents the appearance of a person in good health. In his lungs evidences still remain of the disease he has so many years combated.

Although he has made three attempts to live in New York, at intervals of two years, each time his removal from the mountains has been followed within ten days by a chill, and a return of pneumonic symptoms—symptoms so ominous that he has become convinced that it will be necessary for him to remain in the Adirondack region for some time to come.

FIG. 1. LOOMIS SANATORIUM, SULLIVAN COUNTY, NEW YORK

FIG. 2. LOOMIS SANATORIUM, SULLIVAN COUNTY, NEW YORK. PORCH OF OLD INFIRMARY

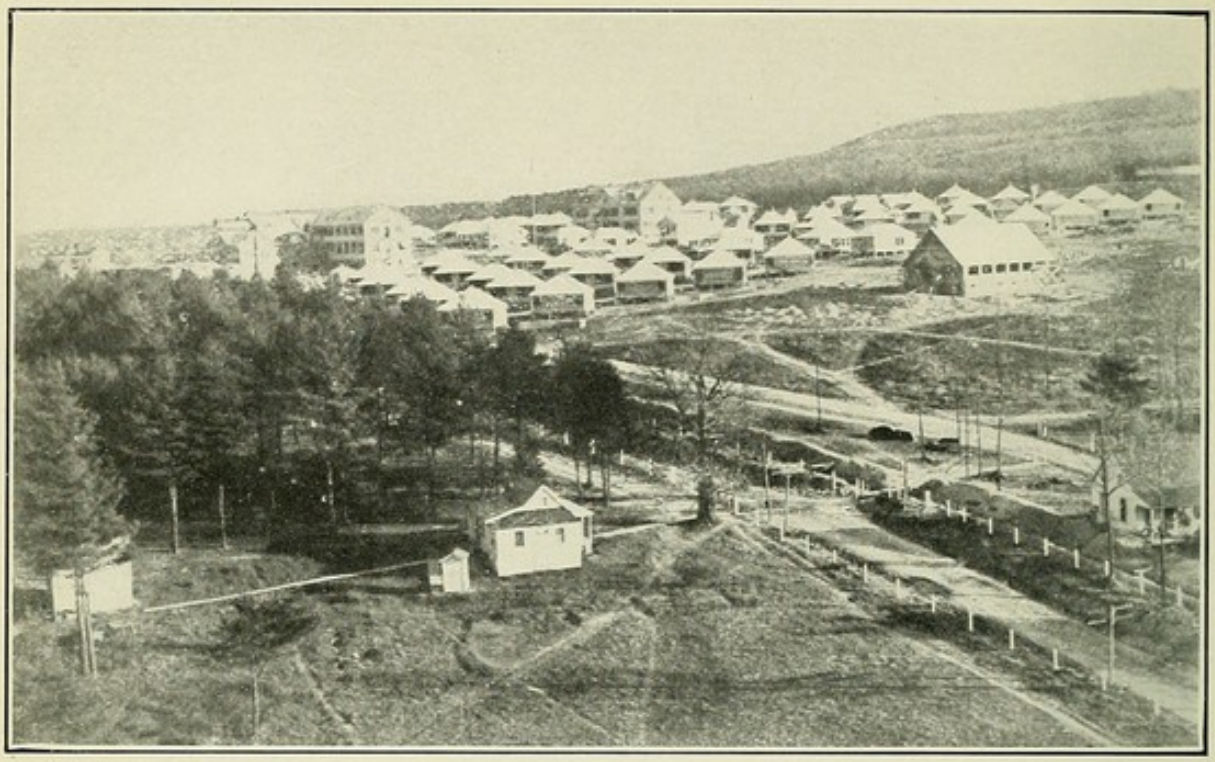


FIG. 1. PARTIAL VIEW OF PENNSYLVANIA'S STATE SANATORIUM FOR TUBERCULOSIS NUMBER 1, MONT ALTO, FRANKLIN COUNTY

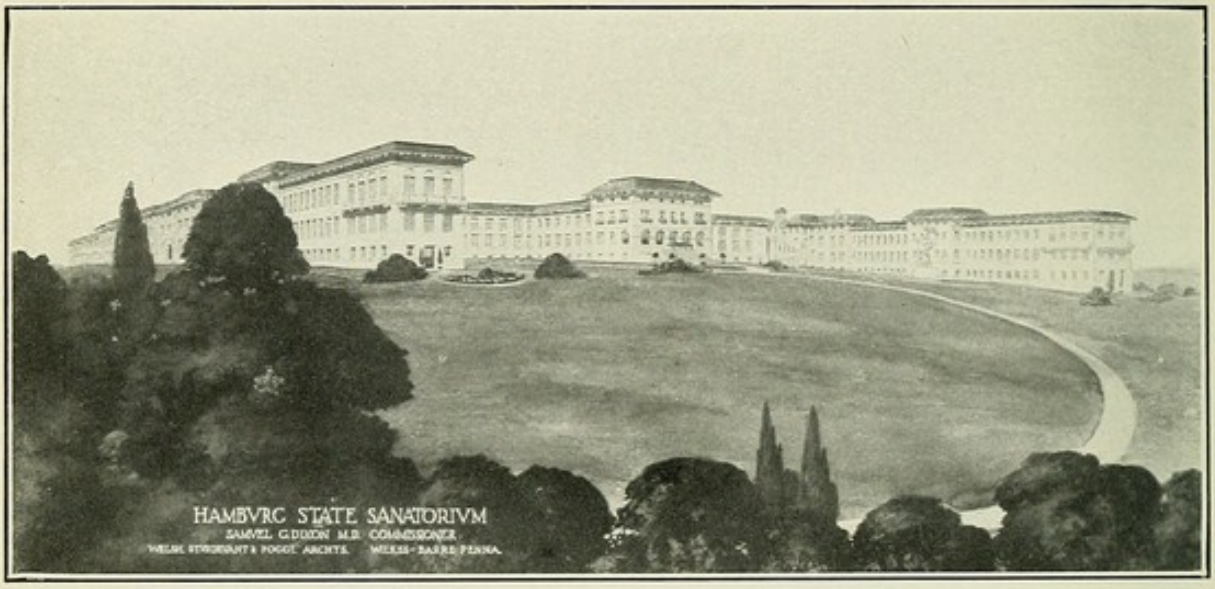
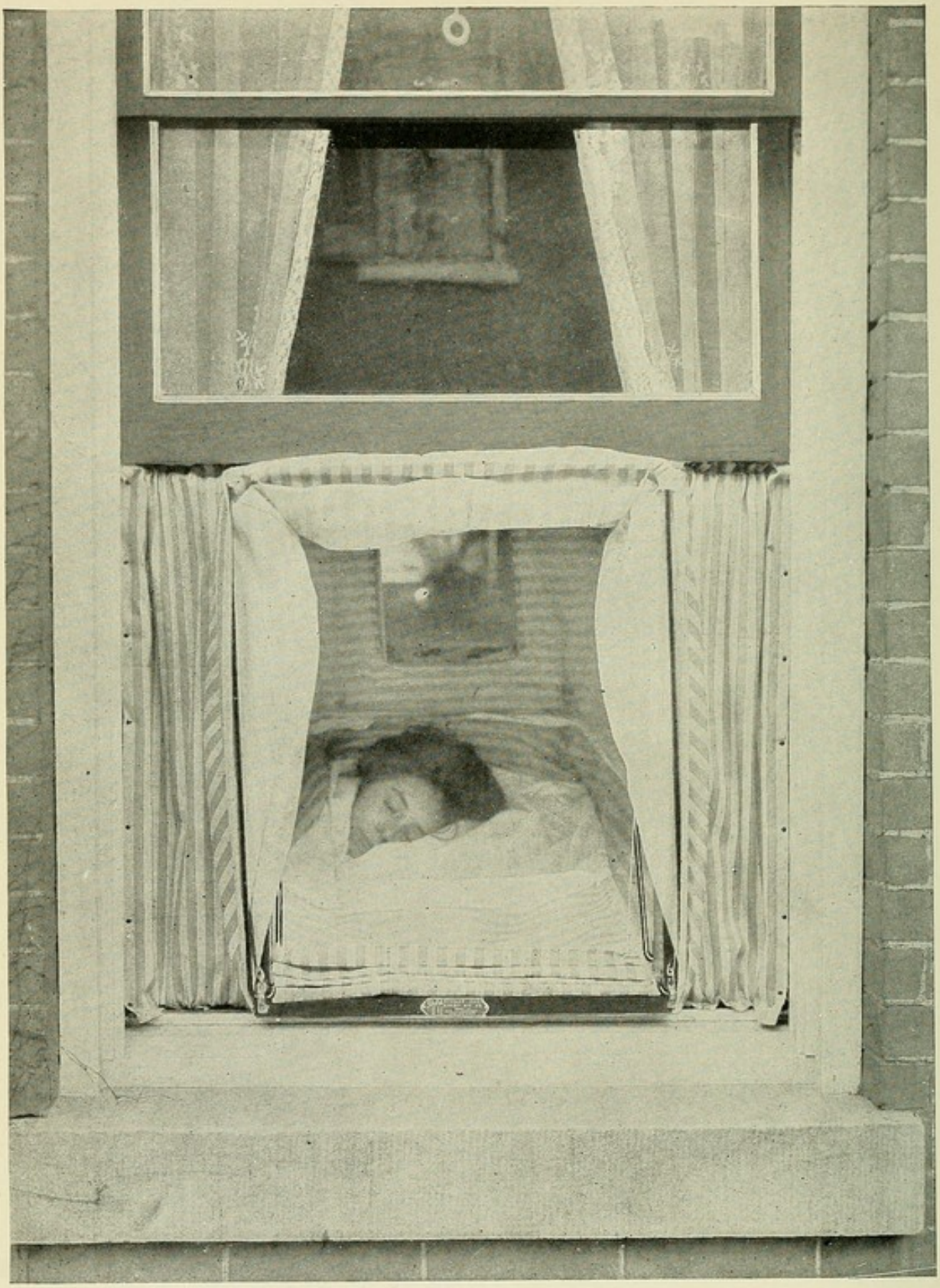


FIG. 2. PENNSYLVANIA'S STATE SANATORIUM FOR TUBERCULOSIS, NUMBER 3, HAMBURG, BERKS COUNTY

PARTIAL VIEW OF PENNSYLVANIA'S STATE SANATORIUM FOR TUBERCULOSIS, NUMBER 2, CRESSON, CAMBRIA COUNTY

This property, formerly a popular summer resort hotel, was presented to the State by Mr. Andrew Carnegie for sanatorium purposes



THE WALSH WINDOW TENT. ALTHOUGH LYING IN THE BEDROOM THE SLEEPER HAS FREE ACCESS TO THE OUTER AIR

We all know the after history of this patient. Thank God, he is still living, still working, and there are thousands living to-day who owe their lives to the example which he has set them. He seized the principles of climatic treatment and adapted it to the individual.

I recently sent the following question to the deans of medical colleges in Boston, Chicago, New Orleans, Los Angeles, and Montreal. I knew nothing of the views of these men on this subject except one; of course we all know that every one from California has decided views on climate. The question was:

What would you do for yourself climatically if you were told for the first time that you had incipient pulmonary tuberculosis?

Here are the answers:*

I would strike for the wild pine woods of northern Michigan or Wisconsin and stay there.—A. R. Edwards, Chicago.

In answer to your question I may say that if I had incipient tuberculosis I should either go to Saranac or St. Agathe in Canada and employ the open air treatment.—F. J. Shepherd, McGill University, Montreal.

In answer to your question of December 26, I would say that I would treat myself as I do patients on whom I make the diagnosis of incipient pulmonary tuberculosis, that is, refer them to a local man who specializes in this disease, and ask him to look them over and refer them for climatic treatment in accordance with his knowledge of climatic conditions suitable to the individual case. Were I to start out to select a climate for myself, I would be much more influenced by the physician under whose care I would come in the new place than by the actual climate, and would probably select either Saranac Lake or Asheville, N. C., as I know and have confidence in physicians in each place. Were they to decide that I was better suited to some other climate, I would move on under their advice. If it were possible, I believe that I would undoubtedly leave Boston, had I incipient tuberculosis.

Very truly yours,

HENRY A. CHRISTIAN,
Boston.

If I had to answer your question categorically I would say that I would ask the advice of one or two men living in my own community as to what I should do for myself climatically if I were told for the first time that I had incipient pulmonary tuberculosis.

The practice among the profession in New Orleans is to send patients to St. Tammany Parish, in Louisiana, where the growth of piney woods is thick and ozone plentiful. When the particular case justifies, the patient is sent to the plains of Arizona or New Mexico, and, rarely, to El Paso, Texas. A few patients go to Colorado.—Isadore Dyer, Tulane University, New Orleans, La.

Perhaps I can best answer this personally by telling you what I did when I was told this very thing fifteen years ago. Having contracted tuberculosis in New York city I sought a better climate for an outdoor life, spending the first summer in the Adirondack Mountains and in November of that year

going to California, where I lived for one year in the foothill region near the coast at an elevation of 1,000 feet, free from responsibility and work. After the first year I never had any return of my pulmonary tuberculosis.

I believe a change of climate is more a question of finances than anything else. If one has not the necessary means to have what is right in a different climate his chances for a cure are much better with home treatment, but when a better climate can conveniently be added to other measures of treatment for pulmonary tuberculosis it should be advised.—W. Jarvis Barlow, Univ. of Southern California, Los Angeles, Cal.

NOTE.—For the bibliography of tuberculosis in its various relations the reader is referred to the Index Catalogue of the Surgeon-General's Library, U. S. Army, Volume 18, Second Series, Washington, 1913. This bibliography embraces 412 pages in double columns, an invaluable contribution to the history and literature of this subject.