Thesis for
The M.D. Degree.
Submitted by
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of 6, Theatre Street.
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The treatment of Pulmonary Tuberculosis.
For the composition of this thesis the following works and publications have been consulted.

The Disease of the Lungs. Foster and Godlee 1878. (Longman & Co.)

Discussion on the Open Air Treatment of Tuberculosis on November 14, 28th and December 12th, 1900 opened by J. Kipling Butler, M.D.

and continued by

Sir W. Broadbent, Dr. Alfred Hillei
Prof. Boyce, Dr. Sidney Martin
Dr. Talbot lamming, Dr. F. T. Lock
Dr. Humann, Dr. Reutt
Dr. Clifford Allbutt, Dr. Washburne
Sir R. Inglis Smith, Dr. Walter
Sir H. Weber, Dr. F. Parkes Weber
Dr. Race, m. Spencer Waltham
Dr. Hearn, m. Isaac Gould
Dr. Edward Squier, The President
Dr. Snee
Dr. Kiriak Sors.

Read Volume 83 of the "medico-chirurgical transactions." (H. K. Lewis 1900).
The open air treatment of phthisis in England.
by Francis Pott, M.D.
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by W. Bardsley, M.D. Edin.
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British Medical Journal, April 1839.

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By Hermann Weber, M.D.
British Medical Journal, June 3, 1839.
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By R. Buchanan M.D.

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By Arthur Ransome M.D.

Remarks on Sanatoria for the Open-Air Treatment of Consumptiùn
By Arthur Ransome M.D.

Reports on the Open Air Treatment of Phthisis in Sanatoria. (Various Reports).

The Practice of Midwifery
By. Redwine Taylor M.D.
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(H. K. Lewis, 1879)
The treatment of Pulmonary Tuberculosis.

It is the object of this paper to pass in review the various forms of treatment (medicinal or otherwise), that have from time to time been introduced on the ground that they either cured, or in some way modified the course of Pulmonary Tuberculosis.

The treatment of the disease by drugs alone, cannot be said to have achieved results of a far-reaching character; while certain drugs would seem to exercise a decidedly beneficial action on the course of the disease, it cannot be claimed for any single pharmacological remedy, that it alone, has cured Pulmonary Tuberculosis.

In the domain of "Hygiene" on the other hand, what may be termed the "climatic, dietetic" or "open air treatment," would seem to have achieved the best results ever obtained; after reviewing the chief
remedies were, and considering the effect of climate upon Pulmonary Tuberculosis, it will be the object of this Thesis to indicate the lines upon which the "open air treatment" should be conducted, and to ascertain what are its claims to be considered as a therapeutic or curative agent, when pitted against a prevalent and deadly disease.

It is of course well-established that a form of "open air treatment" was successfully practiced by the ancients. This however, fell into a regrettable desuetude, and in modern times, the first landmark on the road to success was undoubtedly the introduction of Cod Liver Oil as a remedy for "Scurvy" by Hughes Bennett in 1841.

Some old-fashioned treatments:

The following "treatments" however may just be noted as having been introduced during the lifetime of the more senior members of the medical profession who
The artificial production of Pulmonary Emphysema.

A. T. Ramsay introduced this form of treatment, based on the assumption that the co-existence of Emphysema and Phthisis is incompatible. This object was therefore to produce artificial Emphysema in a patient already the subject of Phthisis.

To this end he devised a long india-rubber tube, through which the patient was made to forcibly expire.

The idea seems crude; but one cannot ignore the fact that the special local condition produced by residence at high altitudes, and contributing so materially to the good results obtained in modern times by the mountain treatment of Pulmonary Tuberculosis, is, according to Theodore Williams, "a chronic local vesicular emphysema developed around, and accompanied by fibrous contraction and shrivelling of the tubercular masses."
The administration by the stomach of
Pancreatic Secretions, on the assumption
that tubercle was a crude albuminous
matter, which had failed to be emulsified
by the pancreatic juices. The only reason
adduced in support of this curious conclu-
sion, was, that disease of the pancreas
had been found in a case of tuberculosis!

The administration of a pill containing
Quinine, Digitalis, and Opium.
This was known as "Niemeyer's Pill," and
was administered on "antiphlogistic"
grounds; tubercle, it was asserted, being
a true inflammatory process.
It probably relieved certain symptoms,
and conduced to the patient's comfort.

The administration of oxygen, on the
theory that tubercle was unconsumed
carbon. The relief given by oxygen
in the dyspnea of practically moribund
cases, is indisputable, and within my
own experience.
Cod Liver Oil.

Cod Liver Oil was used as long ago as 1772, in the Manchester Infirmary, as a remedy for chronic rheumatism; but it was not until the year 1841, that its therapeutic value was properly recognised. In that year, Dr. Hughes Bennett of Edinburgh advocated its employment in the treatment of gout, rheumatism and scrofula. It has since enjoyed a very extensive use in the treatment of tuberculosis.

The exact composition of Cod Liver Oil is a matter of contention; it appears to contain olein, stearine, acetine, (yielding acetic acid and glycerine when saponified) some bile constituents, and minute quantities of Iodine and Bromine.

It acts by improving the condition of the blood, and anaemic patients often exhibit a healthy glow under its administration. It promotes nutrition and metabolism and has a tendency to cause the deposition or formation of fat in the body. Its action in tuberculosis is probably altogether indirect, and merely depends upon an improved nutrition and conditions.
of the blood which it brings about.

It has been stated by Williams that during the last twenty years, cod liver oil has, with the introduction of more liberal diet, and mild alternative tonics, quadrupled the average duration of physical lives. There is no reason to dispute this assertion.

At the Brompton Hospital, it is given in doses of one or two teaspoonful twice a day.

It should not be given on an empty stomach.

Such larger doses, such as nine tablespoon spoonsful per diem, have been given. Mackenzie is of opinion that this is neither necessary nor beneficial.

The plain oil is preferable to the conclusions, because the per-centrage of oil in them varies greatly.

Malt extract, glycerine, Pancreatic and
Petroleum Emulsions.

The following Table gives all the necessary information with respect to four other preparations, regarded erroneously by some, as a useful substitute for cod liver oil, and enjoying a considerable amount of popularity, viz., Malt Extract, Glycerine, Pancreatic and Petroleum Emulsions.

<table>
<thead>
<tr>
<th>Name of Drug</th>
<th>Nutritive value</th>
<th>Special action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malt Extract</td>
<td>All have some</td>
<td>Helps to digest starchy food</td>
</tr>
<tr>
<td>Glycerine</td>
<td>Nutritive value</td>
<td>Given in hot weather when oil disagrees.</td>
</tr>
<tr>
<td>Pancreatic emulsion</td>
<td>Value, but of no magnitude</td>
<td>Relieves cough.</td>
</tr>
<tr>
<td>Petroleum do.</td>
<td></td>
<td>Tastes, relieves cough.</td>
</tr>
</tbody>
</table>

Creasote.

Creasote, although discovered in 1830, did not attract much notice as a remedy for tuberculosis, until 1877. In that year Poucharde and Guibert recorded their observations on the treatment of pulmonary tuberculosis by creasote. They noted:

- Diminution or cessation of fever.
- Return of strength.
A gradual diminution of night sweats.

In 1897, Sommerbrodt published the results of his treatment of 5000 cases. He concluded that the drug possessed a specific action in tuberculosis.

While this is hardly admirable, its value has been amply confirmed by later experience.

The effects often observed are:

- Return of appetite.
- Diminution of cough and expectoration.
- Abatement of fever.
- Abolition of night sweats.
- Increase of strength.
- Improvement of nutrition.

Only the purest beechwood creasote should be employed. It should at first be given in doses of from one to five minims three times a day, preferably in the form of capsules. The dose may be increased to ten or fifteen minims. It should be taken after food.
If not given in capsules, one of the best vehicles for mitigating its disagreeable taste, is milk. Clifford Beale gives it dissolved in cod liver oil; he begins with doses of from three to five minimis, increased to fifty or sixty minimis three times a day. He states that it is well tolerated, and speaks favourably of the effect of large doses on the patient's condition.

**Guaiacol.**

**Guaiacol** is the principal constituent of creasote, and has recently been a good deal used in preference to the latter. Its taste and odour are less disagreeable than those of creasote, and it is consequently better borne by the stomach. Its dosage is the same as that of creasote, but while more expensive than creasote, its action does not appear to be more beneficial. Squire has given it in very large doses — 60 minimis three times a day, in capsules,
or as an emulsion with tincture of orange with apparent benefit, and absence of toxic effect.

It may also be administered as a local application, appearing to be thus freely absorbed.

Applications of from 10 to 60 minimis may be made at intervals of two or three days, the Guaiacol either being used in its integrity, or mixed with glycerine, olive oil, or tincture of iodine. It may also be administered hypodermically in doses of from 1 to 7 minimis, deeply injected into the subcutaneous tissue.

Neither of these methods have any advantage over administration by the mouth, while the hypodermic method is very painful.

Benzol derivatives.

Appended is a table briefly giving all the necessary information as to the
derivatives of creasote which have been tried in the treatment of Pulmonary Tuberculosis.

"Tonic and other remedies."

Another table is also appended, dealing with what may be termed tonic remedies etc.
<table>
<thead>
<tr>
<th>Name of Preparation</th>
<th>Dosage</th>
<th>Therapeutic Effect</th>
<th>Mode of Administration</th>
<th>Characteristic</th>
<th>Chemical Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creasotal</td>
<td>5 - 30 - 100 minims</td>
<td>Same as creasote</td>
<td>By the mouth, beaten up with the yolk of an egg after meals.</td>
<td>Almost insoluble, causes no gastric disturbance</td>
<td>Breaks up into creasote and caustic soda in intestines.</td>
</tr>
<tr>
<td>Guaiacol Carbonate</td>
<td>5 - 15 grains</td>
<td>Same as creasote</td>
<td>By mouth</td>
<td>Inactive</td>
<td>Split up into creasote, acid and guaiacol in solution.</td>
</tr>
<tr>
<td>Benzocoll</td>
<td>4 - 60 grains</td>
<td>Same as creasote</td>
<td>By mouth</td>
<td>A granular, soot-like, lost in powder</td>
<td>Breaks up into creasote, acid and guaiacol in solution.</td>
</tr>
<tr>
<td>Guaiacolate of Piperidine</td>
<td>5 - 25 grains</td>
<td>Same as creasote</td>
<td>By mouth</td>
<td>Belly force by the stomach.</td>
<td>Breaks up into creasote, acid and guaiacol in solution.</td>
</tr>
<tr>
<td>Guaiacol and Menthol</td>
<td>1 drachm of the following solution: Guaiacol 2 parts, Menthol 10 parts, Glycerine 88 parts</td>
<td>Useful in bronchitis and phthisis</td>
<td>Injection</td>
<td>Inhale</td>
<td></td>
</tr>
<tr>
<td>Name of Drug</td>
<td>Route of Administration</td>
<td>Dose</td>
<td>Therapeutic Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------</td>
<td>------</td>
<td>-------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hystrophiae Oxide</td>
<td>By mouth</td>
<td>ordinary</td>
<td>Good as tonic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfaniline Hydrochloride</td>
<td>By injection</td>
<td>ordinary</td>
<td>Some benefit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphathiazole</td>
<td>By injection</td>
<td>ordinary</td>
<td>Some benefit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydroxyquinoline</td>
<td>Oral</td>
<td>ordinary</td>
<td>No lasting benefit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cinnamic Acids</td>
<td>Oral</td>
<td>1/2 - 15 min.</td>
<td>All of the above</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: All of the above compounds are used as a 5% intravenous solution.
The treatment of special symptoms.

1. Fever.

Night sweats: — The following drugs have been given individually, or in various combinations, for the night sweats of Phthisis.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxide of Zine</td>
<td>grs. 5</td>
</tr>
<tr>
<td>Extract of Belladonna</td>
<td>gr. 1/2</td>
</tr>
<tr>
<td>Atropine</td>
<td>gr. 1/100</td>
</tr>
<tr>
<td>Extract of My. Vomica</td>
<td>gr. 1/2</td>
</tr>
<tr>
<td>Hyoschins</td>
<td>gr. 1/20</td>
</tr>
<tr>
<td>Arsenic</td>
<td>gr. 1/12</td>
</tr>
<tr>
<td>Picrotoxin</td>
<td>gr. 1/60</td>
</tr>
<tr>
<td>Camphor acid</td>
<td>grs. 20</td>
</tr>
</tbody>
</table>

Of these, oxide of Zine is probably the most satisfactory.

2. Hæmoptysis.

Morphia  gr. 1/4 hypodermically.

Tincture of Hæmorrhæis m. 20 — 60.

Ergotin grs 1—2 hypodermically.
Antimony

S. 1/60 every half hour.

Of this, ergotin, hammamelis, and antimony are probably useless.

3. Cough.
The successful medicinal treatment of phthisical cough depends so much on the sensible discrimination of its nature, that the subject will be left for the present, and discussed under the "chimato dietetic" treatment.

The "specific" treatment.

In August 1890, eight years after his discovery of the tubercle bacillus, Professor Koch stated at a general meeting of the International Medical Congress, held at Berlin, that he had, after prolonged research, discovered a substance, which when inoculated into a guinea pig renders it incapable of re-acting to the inoculation of the tubercular bacillus.
"The same substance he went on to state, "in guinea pigs already attacked with advanced and general tuberculosi, brings about a complete arrest of the development of the malady, without the animal suffering any harmful effects from the influence of the remedy."

The substance was a glycemic extract of pure culture of the tubercle bacillus.

The discovery created intense excitement, and I personally witnessed the inoculation of several cases of pulmonary tubercle, and of lupus at Edinburgh, under the direction of the late Sir Thomas Grainger Stewart.

The results were disappointing; and with regard to the Edinburgh cases, I think I am right in stating that one case at least, succumbed as the direct result of the treatment.

After a long and careful trial of
"Tuberculin" as it was called, at the Brompton Hospital, Dr. Williams and Tatham of that Institution, thus summarised the results.

1. That tuberculin, if introduced under the skin, speedily causes inflammatory changes in, and around tubercular lesions.

2. That the action of tuberculin in lung tuberculosis, is to cause breaking down of the tubercular masses, and of the lung tissue in the neighbourhood, and thus to promote the formation of cavities. That this is the case, is proved by (a) the appearance of lung tissue in the sputum, where it was previously absent, and (b) by the physical signs of cavity replacing those of consolidation.

3. That tuberculin increases the amount of expectoration, but that there is no proof that it diminishes the number of tubercle bacilli contained therein, for in some of the patients they apparently
increased under its use.

4. That in many cases tuberculin injections are followed by a distinct extension of disease, as evidenced by physical signs.

5. That the reactions due to tuberculin are exhausting to the patient, and cause loss of weight and strength.

6. That this treatment is specially contra-indicated in lung tuberculosis accompanied by pyrexia, as likely to convert intermittent into continuous pyrexia.

7. That lassitude or accompanying the use of tuberculin may be followed by contractile changes due to increase of fibrosis. This was shown in two of the cases under observation, where diminution of cough and expectoration, and gain of weight took place.

8. That tuberculin did not favourably
influence the course of the disease in
the majority of cases; that in some,
the effects were detrimental, and that
even in the stationary and improved
cases, it was difficult to ascribe any
distinct improvement to the injections
which might not have been equally
attained under the treatment ordin-
arily employed in the hospital.

Since 1890, Professor Koch has still expre-
sed his belief in the efficacy of Tuberculin.
Though perhaps, with somewhat modified
eagerness.

At the same time he has brought forward
three new preparations:

Tuberculin A.
Tuberculin O.
Tuberculin B.

Tuberculin A. is produced by pounding
and extracting Tubercle bacilli with their
normal caustic soda. From this are ob-
tained substances derived from the protein
components of the bacilli.
It produces results very much like that of the old Tuberculin, but relapses are less frequent.

For the preparation of Tuberculin O and P, masses of dried culture are carefully powdered in an agate mortar; the mass is then dissolved in distilled water and centrifugalised. The material separates into two layers, a slightly opalescent supernatant fluid Tuberculin O, and a colloidal mass containing a few tubercle bacilli, Tuberculin P.

It is claimed for Tuberculin P that it exerts immunising and curative effects, and that cases of Tuberculosis and Lupus in an early stage are, without exception, greatly improved by its administration, and that no unfavourable results attend its use.

The whole matter, however, of the so-called
"Specific treatment" is still sub judice.

The Serum Treatment.

Maraghius of Genoa, claims to have produced a serum having a specific curative action on Tuberculosis. He states that:

1. The remedy is quite innocuous.
2. It has caused a subsidence of the fever.
3. It has modified local morbid processes.
4. It has caused the bacilli in the sputum to diminish or disappear.

The serum is obtained from dogs, asses, and horses, who have been injected with toxic principles extracted from living bacilli.

The use of this serum in Germany has been attended with failure.
Nucleins.

Nucleins are complex protein bodies containing a large quantity of phosphorus. They may be obtained from yeast = yolk of egg = the spleen, and other sources. Their administration has been observed to be attended by an increase in the white corpuscles of the blood; some are believed to possess germicidal power. Their exhibition is stated to have produced beneficial results in cases of pulmonary tuberculosis, in the incipient stage of the disease.

Sixty to eighty minims of a one percent solution are hypodermically administered daily. By the mouth, larger doses are given.

Preparations.

As far back as 2000 years, hygiene and dietetics were recognised as the fundamental requirements for the
Treatment of consumption.

The first account of consumption is found in the writings of Hippocrates (460–377 B.C.), and he recommends residence in a suitable climate, and good living for the treatment of the disease.

Celsius, Pliny, and Galen all agree as to climatic treatment: Celsius for sea air, Pliny for sunshine and pine forest, Galen for residence in pure air, and the mountains for the "milk cure."

The Arabian school advocated the same methods; Avicenna sent his patients to Crete, "to cleanse the ulcers on the lungs."

In spite of the evident recognition of these fundamental lines of treatment, it is stated by Illissperger [1867] that there are barely 200 cases of reported cure, since the time of Hippocrates, and throughout a long period the disease was regarded as incurable.
This is remarkable, but the absence of pathological knowledge must be taken into consideration; nothing is more striking than the conviction ultimately borne in upon sane minds by careful post mortem observation, that Phthisis was a curable disease.

In the year 1857, Brehmer introduced a national system at Göbersdorf: this was the model upon which the modern system of "climato dietetic" treatment in its various forms was founded; from this method of treatment, by far the best results have been achieved.

As an introduction however to the study of the "climato dietetic" treatment, it is necessary first of all to consider, by itself, the part played by climate in the treatment of Pulmonary Tuberculosis.

Treatment by residence at high altitudes

Williams claims that this treatment origin
ated in Peru and Bolivia, where, according to Archibald Smith, Phthisis prevailed in an acute form, at the sea level. The custom was to transport consumptives to towns and valleys in the Andes, at an elevation of from 8000, to 12,000 feet. There, after prolonged residence, they gradually recovered; the treatment spread to N. America, to Europe, and later on, to South Africa and India. Similar results have been obtained at high altitudes, in all quarters of the globe.

Mountain climates possess three characteristic qualities.

1. Diminished barometric pressure, and consequent rarefaction of the atmosphere.

2. Diathermancy of the air, or the increased facility with which the sun's rays are transmitted. This causes an increase in the difference between sun and shade temperature, of
1°. For every rise of 235 feet.

3. Asepticity, or freedom from organic germs.

The effect of mountain air upon the functions of healthy and sick persons is as follows,

A. The skin fatigued.

B. The circulation is quickened, and the heart's action is more powerful; the pulse rate at the end of six weeks is lessened, or lower than normal.

C. The respiration is at first quickened, but after a similar interval, gradually slows, and falls below normal; inspiration is longer; expiration—more complete.

D. The blood pressure is reduced.

Less urea is excreted by the kidneys.
More carbonic acid and water is excreted by the lungs.
When acclimatisation is complete, urea appears in full quantity in the urine, and the blood pressure falls.

E. The thorax expands in different directions; the circumference of the chest may increase from one to three inches at different levels.

F. More oxygen is consumed; more carbonic acid given out, and the red corpuscles increase rapidly in number.

The general effect on selected cases of chronic tuberculosis is excellent; the weight is increased - the muscular power augmented - and prolonged exercise becomes possible.

The local effect.

Cough and expectoration diminish. The bacilli disappear.

The thorax expands, and hypertrophy of healthy lung takes place. Chronic
Local vesicular emphysema is developed around the tubercular masses, which undergo fibrosis, contraction and shrivelling.

The physical signs are:

A. In consolidation.

Hyper-resonance over both lungs, and disappearance of all areas of dullness bronchophony and crepitation, also the substitution of a dry harsh breathing, which is like the compensatory breath sound heard over the unaffected lung in a case of pleuritic effusion. In early consolidation cases, the disappearance is absolute.

B. In softening and excavation.

Disappearance of moist and cavernous sounds, and sometimes signs of consolidation, owing to development of emphysema around the lesions.

The cases that do best, are those with consolidation of one or both apices.
The softening and excavation cases of course, do not do so well.
Single cavity cases, with opposite lung free from disease, do better than cavity cases with double affection.

The best age is between 20 and 30.

The treatment is specially indicated, where hereditary predisposition is a marked feature.

Recent cases do best.

Hemorrhage is benefited, but cases with marked ulceration or aneurysmal condition of the pulmonary vessels should keep away from high altitudes.

Marked pyrexial cases are made worse.

The contra indications are:

Double cavity cases, and all forms of advanced pulmonary tuberculosis.
Catarrhhal Phthisis.
Laryngeal Phthisis.
Acute Phthisis of all kinds.
especially where great irritability of the nervous system exists.

Length of Residence
A sojourn of at least six months is necessary
and in long standing cases, a year or more
may be required.

Desert climate.

The following is a fairly complete list of the accessible deserts of the world.

The Mohave & Colorado deserts, California.
The Mexican desert.
The Peruvian desert.
The Kalahari and Karoo deserts, S. Africa.
The inland desert of Australia.
The desert of Turkistan.
The Tibetace desert.
The Red sea desert.
The Egyptian desert.
The Biskra desert.
The Sahara.

Of these, the Egyptian desert is the one almost invariably selected for consumptives. The marked feature of the climate would seem to be the extraordinary quantity of ozone. There is a maximum amount of sunshine, and the sunlight is more intense, owing to the dryness of the air, while the refreshing winds that usually blow about 75 per cent more during the day than the night, successfully prevent the sun heat being dangerous to the head. Freedom from rain, and absence of germs, are factors which must not be overlooked.

The disadvantages are, the occurrence at certain periods of hot, dust-laden winds from the desert, and at others cold winds, and the prevalence of intestinal disorders.
The best way is to take a trip up the Nile by dahabeyah; camping out in the desert may also be tried, but both of these methods are very expensive.

Apart from the distraction of mind occasioned by a sojourn in a land so full of interesting archaeological associations, there really seems no special advantage in its selection for the treatment of Pulmonary Tubercle; while, to people of limited means, the expense entailed by a sojourn in the Egyptian desert is prohibitive.

The Riviera

The climate of the French and Italian Riviera is suitable for advanced cases of disease, or where high altitudes are contra indicated. There is higher atmospheric temperature.
considerably more sunshine, and less rain than in Great Britain.

The disadvantages are:— the great difference between sun and shade temperature. The marked fall of temperature immediately after sunset, and the prevalence at certain times, of very dry, or winds.

The most sheltered place is the eastern bay of Mentone, but this is only suitable for very weak patients, owing to the protection from wind, and the full exposure to the sun which it enjoys, robust patients become enervated by the climate.

In the western bay, the air is cooler and decidedly more bracing. Cote d'Azur, Nice, Cannes, Grasse, Cape Martine, Monte Carlo, Bordighera, San Remo, and Alaceio, being much frequented resorts.
Burney Yeo thinks the Riviera climate by no means a perfect one, but admits the advantages of the large proportion of fine sunny days, as enabling the invalid to spend much time in the open air.

South Africa.

The characteristics of the S. African climate are abundant sunshine, a dry rarefied and exhilarating air, and a pleasant sub-tropical temperature.

One of the principal advantages of its selection, is undoubtedly the opportunity afforded of obtaining employment when the health has improved, and of thus making a permanent home in the country.

A list of S. African districts suitable for consumptives is given below in their respective order of merit.
2. Grass plains of Griqualand West - Orange Free State and South Bechuanaland - Bloemfontein - Kimberley - Greybergh.
3. The higher plateau of Southern Rhodesia - Bulawayo.
4. Distinctly less favourable - Johannesberg and mountain districts - Dordrecht.
5. Upper coast terraces - Queenstown - King Williams Town - Graham's Town - Graaf Reinet - Manitzberg -
6. Unfavourable. The Coast towns.

Madeira.

Madeira has a warm moist climate and is specially suitable for the relief of bronchial catarrh complicating tuberculosis.

In no other condition however, is such a
climate to be preferred to one affording
a pure, dry, cold air.

The climate of the Canary Islands is war-
er and drier than that of Madeira.

Teneriffe and Oratava are especially
suitable also for bronchial catarrh
complicating Phthisis.

**Sea Voyages.**

Sea voyages have no special advantages
but may be considered if the patient
have a special liking for the sea.
He should be vigorous however, and
his disease limited or quiescent.
If such a course be decided upon, he
don't voyage round the Cape to New
Zealand or Australia, or by the Suez
Canal to India, and thence to China
or Japan.

On no account should advanced cases
Mineral Water resorts.

The springs of Eaux-Bonne and Cauterets are useful in cataractous conditions, associated with tuberculosis. Also La Bourboule, Mont Dore', and Enns, in the fibroid variety associated with emphysema and bronchial catarrh.

The general conclusion to be drawn with regard to the question of climate is:— That although the general result may be excellent, no climatic treatment can produce the remarkable changes in the thorax of lungs which obtain after residence in high altitudes.

Appended is Theodore Williams' table showing the comparative results of different climates.
### Results

<table>
<thead>
<tr>
<th></th>
<th>No of Patients</th>
<th>Average Length</th>
<th>Residence</th>
<th>First Stage</th>
<th>Second and Third Stage</th>
<th>Bilateral Affection</th>
<th>General</th>
<th>Local</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Improved</td>
<td>Stationary</td>
</tr>
<tr>
<td><strong>High Altitudes</strong></td>
<td>247</td>
<td>Months 12.2</td>
<td>In Cent. 65</td>
<td>In Cent. 35</td>
<td>In Cent. 37</td>
<td>83.4</td>
<td>2.02</td>
<td>14.57</td>
</tr>
<tr>
<td><strong>Sea Voyages</strong></td>
<td>65</td>
<td>1.6</td>
<td>In Cent. 63</td>
<td>In Cent. 37</td>
<td>In Cent. 37</td>
<td>77.5</td>
<td>21.56</td>
<td>7.7</td>
</tr>
<tr>
<td><strong>Riveria</strong></td>
<td>210</td>
<td>9</td>
<td>In Cent. 59</td>
<td>In Cent. 41</td>
<td>In Cent. 36</td>
<td>65.1</td>
<td>10.2</td>
<td>24.80</td>
</tr>
<tr>
<td><strong>Home Climate</strong></td>
<td>292</td>
<td>9.7</td>
<td>In Cent. 58</td>
<td>In Cent. 42</td>
<td>In Cent. 42</td>
<td>62.7</td>
<td>8.21</td>
<td>28.2</td>
</tr>
</tbody>
</table>
The Pro-dietetic, open air, or Sanatorium treatment.

In 1840, Boddington, a Warwickshire physician, published a work, describing a method of treatment, which embraces nearly all the important factors of the modern open-air method.

It was, however, reserved for Brehmer to first systematise and successfully carry it out; this he did at Jöbersdorf in Silesia.

Brehmer's method consisted in:

1. The residence of the patient in a Sanatorium, and a constant medical supervision.
2. Complete freedom from all forms of excitement.
3. A life spent in the open air.
4. Rest during periods of the disease attended by fever.
5. Methodical hill climbing as an exercise, during periods marked by absence of fever.
6. An abundant and varied dietary.
in which vegetables occupy an important place.

7. Various hydrotherapeutic measures.

The first important modification of this system was introduced by Dettenwiler, who to a great extent substituted rest in "Liegende Halle" for methodical hill climbing.

In this he was probably wrong, but that is a matter for discussion at a later period.

At the present time, Perlschmehl's treatment as carried out by Dr. Otto Wallther at Nordrach in the Baden-Black Forest, and described at length by Fowler, will give as good an introductory idea of the "system" in detail as can possibly be desired.

Nordrach is a small village in the Baden-Black Forest, 30 miles distant from Strasburg.
It is situated in a cul-de-sac at the remote end of a beautiful sub-Alpine valley, 1400 feet above the sea.
The valley is open to the S. West, and shut in by a horseshoe shaped range of hills, rising another 1400 feet on the North and East.
These hills are clothed with miles of pine forests which prevent dust, and afford walks sheltered from the wind.
The rainfall is considerable, and the air is thus "washed" of its impurities; the geological formation being of red sandstone, the heaviest showers are rapidly absorbed.
The climate is variable, warmer than that of England in summer, and colder in winter.

The sanatorium consists of four houses containing 42 separate bedrooms and a dining hall. There are no sitting rooms, the patients thus being compelled to spend most of their time...
out of doors.
All the rooms are carefully constructed to avoid the formation of dust, to cause patients while indoors, to be practically in the open air, and to give the minimum of exertion to those in bed.

The walls and ceiling of each room are of varnished wood, and the floor is covered with linoleum which is swabbed with water every morning. There is ample window space, and hot-air heating apparatus.

The large casement windows are practically open all the year round, so that there is the least possible difference of temperature within and without. As a consequence, "colds" are almost unknown.

The walks on the surrounding forest slopes are varied and picturesque, the nearer ones being specially laid out on easy gradients, with benches at short intervals.
Small shelters from storms are provided. There are practically no amusements; absolute mental as well as physical quietude, being considered a necessary part of the treatment.

The main features of the treatment are

1. An absolutely open-air life for every variety of case, whether acute or chronic, pyrexial or apyrexial, in all weather and seasons by night and by day.

2. A regular course from first to last of overfeeding, with rich diet, including much meat, milk, fatty and farinaceous food given in large quantities at a time, with long intervals between the meals.

3. A judicious combination of exercise (with climbing) carefully regulated so as not to produce dyspnoea or fatigue with the maximum amount of mental and physical rest.
4. The constant personal supervision of a physician.

As to diet, there are three meals a day.

Breakfast at 8 a.m. of coffee, bread and butter and cold meat, with a half litre of milk.

Dinner at 1 p.m. of two hot courses of meat or fish and meat, about six ounces being served to each patient, with plenty of potatoes and green vegetables, and sauces, of which butter is the main ingredient. The third course may be pastry or farinaceous pudding, fruit and ice cream, with coffee and a half litre of milk.

Supper at 7 p.m. One hot meat course and one cold, tea and a half litre of milk.

The Resident Physician presides at the two latter meals, and the plates must not be removed until everything has been eaten.
Special cases in bed, have the same diet, in
if anything, larger quantities.

Patients rest on couches from 12 till 16th,
and from 6 to 7, before meals.

Cases of active disease with high fever,
are treated by rest in bed, over feeding,
and usually by isolation, the exertion
of talking being thus avoided.

When the temperature remains below 38°C
in the evening, and below 37°C in the
morning, for 10 days, the patient is allow-
ed a short walk of about 50 yards in
the morning, the distance being tentative-
ly increased. If the temperature tends
to rise in the mornings to 37°C or above —
rest is again resorted to.

Patients take their own temperature in the
rectum four times daily: — on waking —
at noon, immediately after walk — at 5:
30 p.m. — and before going to bed.

The "exertion" temperature falls quickly,
and should be taken at once. It should
not exceed 30° C.

Walking must be at a slow uniform pace, and at first, several rests should be taken, so as to avoid the slightest fatigue. Talking—except during rests—should be avoided, particularly when going up hill. In certain cases therefore, the patient is made to walk alone.

The first part of the walk is usually an ascent, then a horizontal portion, and a descent home.

As energy recovers, the distance is cautiously increased, regard being given to the temperature, until several miles can be done, involving a climb of five or six hundred feet during the morning, but a slow steady gait must always be observed.

The afternoon is usually spent in rest, or a short walk, and patients go to bed about 9.

The physician visits each patient twice daily, before each meal, except convalescents; there are visited once.
Every patient has one of Dettweiler's patent
flasks, and a cup in his bedroom to re-
servoir spitting; spitting elsewhere is strictly
forbidden.

The chest is examined monthly, and the
ejection carefully tested for tubercle
bacilli at similar intervals.

Patients are not infrequently sick during,
or speedily after a meal; if this happens,
they come back and finish it, and as a
rule, retain it.

The rests before meals, and the long inter-
vals between them, aid digestion, and
dyspepsia is rare. If it be present, it
disappears as nutrition improves.

The absolute rest and over feeding are
stated to be a potent means of reducing the
temperature.

The result of this treatment is — in the
majority of cases, remarkable. Dyspepsia
disappears — anaemia gives place to a healthy colour — weight is made up to the extent of twenty to fifty pounds — cough and expectoration diminish — and physical signs correspondingly decrease, the whole constitution becoming totally re-organised.

Finally — bacilli can no longer be found in the expectoration.

As a final test, some expectoration is injected under the skin of a guinea-pig, and an interval of 3 or 4 weeks allowed to elapse. If no signs of tuberculosis develop in the animal, the patient is allowed to return home, often to do moderate work, at once.

The probability is — that the Norderach treatment, as above described, carried out, as it is — with great care, and intelligent attention to detail, includes all the elements most essential to success.

There are however, minor points and modifications, upon which it is necessary to touch; and finally, the consideration
— very briefly — of the "open air treatment in Great Britain" claims attention.

The Sanatorium.

The sanatorium should be situated on a warm, dry soil; its foundations should be solid and damp-proof.

It should be so placed, as to be naturally sheltered on its colder and more windy sides, by woods or higher hills, preferably by both.

The building itself should be arranged to give additional protection. To this end, the main block may have diverging wings with a sheltered terrace between, as at Falkenstein and Hohenhonnorf.

A verandah is a practical necessity, and should be placed on the "sunny side" of the building, but not so as to interfere with air and light. If possible — it
should be well away from the bedroom windows of the patient, so that those in bed may not be disturbed by conversation carried on below.

The grounds should be spacious, and walks of various gradients provided to facilitate graduated exercises.

The sanatorium may be constructed in the form of a single building, or as a series of detached cottages or villas. If possible, a combination of the two systems would seem to be most suitable. The large building costs less to erect, is more easy to supervise, and requires a smaller staff. Moreover—lifts—so necessary for feeble patients, can be introduced.

The cottage or villa system, on the other hand, permits of the easy isolation of cases becoming infected; the cases too can be more easily classified, and there is necessarily greater quietude.
In England, where the "detached" system is adopted, covered ways between the different villas are essential, on account of the uncertain climate.

The necessity of limiting the number of patients will be apparent, if they are to receive adequate attention. The Resident Physician will be fully occupied with 30 or 40, and there is an evident danger of the sanatorium degenerating — as is the case in some continental institutions — into a mere dividend paying "hotel" if unwise limits are admitted.

At the same time, from the point of view of infection, the danger of aggregation has been amply demonstrated to be nil — if proper precautions are taken.

The evidence adduced by Dr. Pollock to show the immunity enjoyed by the Resident Staff of the Brompton Hospital, conclusively proves, that with due precautions, there is no danger in grouping tuberculous patients under one roof.
If the building be rectangular, one angle and not one side should point due North. Thus, the sun plays on every side of the house in summer and winter alike. The bedrooms should face south as nearly as possible.

The drainage and water supply should be "beyond suspicion."

As to the Interior of the Sanatoria...

Fixed carpets and unnecessary hangings should be avoided, and the rooms should be constructed so as to avoid all useless angles and ledges, while the corners should be rounded. Stuffed furniture, which, for comfort is essential for indoor use, should have washable covers.

There should be no wall papers; the floors should be waxed, painted, or covered with linoleum.

The patient's rooms and furniture should
be cleaned with damp cloths, and disinfected with perchloride of mercury, in the form of a spray, after their departure.

The cubic space should be large, and window space considerable; the ventilation will be chiefly effected by the windows. Heating can be maintained by low-pressure steam or hot water. Electricity is the most satisfactory form of lighting. Rooms for hydrotherapy, containing baths, douches &c, should be provided.

**Exercise.**

Bachman held that the form of exercise most suitable for cases of pulmonary tuberculosis was slow, uphill walking. After arrest has been obtained, and until the lesions have become "obsolete" it is safest to restrict the patient to walking exercise.

The hill climbing strengthens the heart, and increases the functional power of the remainder.
The sanatorium should therefore, be in a hilly district, if possible. It should not be at the top of a hill, but at the bottom; if the patient starts by climbing, he is not likely to wander too far from home, the return to which, if downhill, is rendered easy.

**Diet.**

The Nordenbach treatment offers an excellent model in respect of the diet. The point to emphasise seems to be, that mere forced feeding without judicious exercise, is useless, if not deleterious, and is probably both. It is quite clear that a mere increase in weight is not necessarily coincident with arrest of the pulmonary disease, and there is no object in rendering the patient merely flabbily fat, and sending him home again "in static quo" so far as lung trouble is concerned, or possibly, with an extension of disease.
The "Dettwiller" system aimed at the maximum of food with the minimum amount of exercise, and although the author claimed to have cured 13 per cent. of the patients at any rate, are few in the present day; however, the system of hill climbing advocated by Aertel as strengthening the heart, has stood the test of time and of investigation, and the general consensus of opinion is in favour of regulated exercise in the treatment of pulmonary tuberculosis, except where extreme activity of the disease is manifested by the patient's temperature.

Fever and rest.

Cases of high fever indicating the presence of active disease, should be at rest in bed, in absolutely quiet surroundings.

Rest in bed should be maintained as long
as the temperature is not subnormal in the
morning, nor rises above 100. 1°F. in evening.

When for at least a week, the temperature has
been below normal in the morning, and below
100.1°F. in the evening, the patient should
get up and take exercise.

Exercise should at first be of the mildest
kind; a walk about the room — next, a
walk of fifty yards or so out of doors,
the distance being gradually increased
as long as the effect of exertion upon the
temperature is not so marked as to cause
a rise above 100.4°F.

If fever returns — the amount of exercise
must be diminished, or the patient must
remain completely at rest.

The necessity of strict supervision.

The necessity for strict regulation & supervision
of the patient's lives in every detail must be
obvious; each case must be separately
considered, and the daily routine mapped out and faithfully adhered to, if a successful result is to be hoped for. It is impossible to emphasise this too strongly! Trained nurses are essential, as well as a resident physician in every sanatorium.

The aid derived from medicines. This has already been considered in most of its aspects; the treatment however of cough and gastric disturbance call for special remark.

As regards cough—the indiscriminate administration of sedatives is to be condemned. The chief points to which attention has to be directed, are the time of occurrence of the cough, whether it is effective in expelling secretion, and whether it prevents the patient from obtaining sleep.

A cough which occurs in the morning, and is accompanied by expectoration, is useful, and should not be checked; hot milk with stimulant, assist it; a draught of ether and ammonia, or a warm alternative...
draught may be given with good results.

A similar method of treatment is often useful in relieving cough which occurs on lying down at night.

If the cough continued during the night and prevented sleep, a mixture containing codeina or morphia should be given. Sedative cough mixtures, however, are to be avoided, if possible — as they spoil the appetite.

An irritating and ineffective cough persisting during the day is best treated by the use of inhalations or sprays. Twenty drops of a saturated alcoholic solution of menthol or a similar quantity of a mixture consisting of equal parts of creasote or guaiacol and spirit of chloroform are examples of useful dry inhalations. When there is laryngeal catarrh, the use of a steam inhaler containing a drachm of compound tincture of benzoin to a pint of water at 140°F. sometimes affords relief. When there is excessive secretion, codeina or Belladonna may be cautiously used.
It is essential that the alimentary tract should be in good condition. As a rule, when the case first come under treatment, the functions are impaired; some anaemia is usually present, perhaps vomiting—occasionally diarrhoea. Appetite can generally be restored by a soda and quinine mixture; hydrocyanic acid or strychnine may be usefully combined with it.

The object aimed at, the maintenance of arrest.

The open air treatment "probably acts in no other way than by increasing the general resistance of the body to the inroads of disease. The aim of the treatment of Pulmonary Tuberculosis is..." says Kingston Fowler, to first obtain quiescence of the disease, and then...its arrest. But this is not sufficient; in course of time, the lesions undergo fibrosis and become "obsolete."

These changes, briefly put, are:

1. Fibrosis, and fibroid transformation of tubercle, accompanied very often by calci-
Fibrication of caseous areas; this is the commonest, and of course, the safest form of tubolet lesion.

2. The formation of a fibrous capsule round a caseous area, which remains in a state of caseation; this is rare, and comprises great possibilities of future danger.

3. The contraction of a cavity owing to fibrous changes in its walls, and in the neighbouring lung tissue.

It is most important to remember, that for these changes to take place, a long period, running into several years, is required. Failing this, there comes a relapse as soon as the patient is again subjected to the strain of a busy life.

Fowler states that he knows of a case where a fibrous capsule enclosing a caseous mass, broke down after 42 years with a fatal result.
A favourable result therefore can only be maintained by the patient ordering his life upon lines as similar as possible to those which effected the arrest of the disease. Though exceptions may exist, it may safely be said that no patient who is the subject of arrested Pulmonary Tuberculosis, can ever again undertake, with impunity, the responsibilities of a busy, much less of an irregular kind of life.

To claim, for the "open air treatment," not only an absolute cure, but the maintenance of it, under a return to the conditions of life which caused it, is as absurd, as it is unreasonable.

At the same time, it has afforded results more beneficial and more lasting, than any other "Method" yet devised.
Sanatorium Statistics. All stages.

Sir R. Weben.

Perfect recovery 13 per cent.
Nearly perfect 15 " "
Great improvement 26 " "
Stationary 22 " "
Become worse 22 " "

Dettweiler [Falkestein].

Cured 13 per cent.
Improved 24 " "

Prehmer [32 cases] during 10 years

Cured 11 per cent.
Nearly cured 15 " "
Improved 26 " "

Theodore Williams [350 cases treated at high altitudes].
Disappearance of all symptoms 41 per cent.

Great improvement 70 " "
Stationary 2 " "
Become worse 12½ " "
The Open air treatment in England.

The Open air treatment has been carried out in England with excellent results. Almost the first, if not the very first, series of cases published, related to the trial given to the "System" at Cromer in Norfolk, under the supervision of Dr. Burton Fanning.

Dr. Fanning has been engaged for more than 2 years in treating cases on the Norfolk coast. The subjects being patients drafted from the Norfolk and Norwich Hospital, he was at first able to do little more than keep them out of doors without extra dietary. This first series made encouraging progress, and when in a second series the food was able to be increased, distinctly better results were obtained.

Lastly—with strict medical supervision, and opportunities for systematic exercise—the third series of patients have shown better results still.

Burton Fanning is of opinion that
careful regulation of the patient's life is of infinitely greater importance than mere change of climate; he cites the case of a consumptive who followed the treatment in a yard in the centre of a small town, and who gained 20 lbs. in two months, and made corresponding progress in other particulars.

I myself, have had three cases under treatment in their own homes, situated in the "studs" of Norwich, a city with a population of over 140,000. Limited as the means—and imperfect as the surroundings of these patients have been, they have, though all advanced cases, shown a remarkable abatement of local symptoms, and general improvement of condition. At the end of two years, they are all living, and in fair health. Though when I first saw them, they had well-marked disease, and large numbers of tubercle bacilli in the sputum.

The treatment consisted of giving up...
their employment—resting in bed for a stated period till their fever had abated, then lying on a couch, either in the doorway of their dwelling, or near an open window in the remotest aspect obtainable, and finally, when improvement set in, regulated walks in the open air; they were, of course, instructed to sleep with their bedroom windows widely open, and a dietary was followed in proportion to their means, though considerably in excess of what they had been accustomed to.

Another patient, whose circumstances were somewhat better, and who was a case of early Phthisis, and apparently a most unfavourable one, was able to place out at a farm house near Holt in North Norfolk. He took a most intelligent interest in his own case, and implicitly followed the routine prescribed for him, but personally I attribute the highest importance to the fact that his course of life was carefully supervised.
by the local doctor, who regulated exercise, according to his symptoms. He did not at first, make the astonishing progress so often seen described in these cases, but without going into particulars, may state that the result of 18 months' treatment has been a complete arrest of the disease, though of course, the cavitation which existed cannot be replaced by healthy lung tissue. It also shows great increase in weight, and an extraordinary alteration for the better, in his appearance. I saw him last week; he looks and feels quite well, and is ready to commence employment as soon as he can get a suitable post, which will enable him to live, as far as possible, an outdoor life; at the same time I am convinced that if he returns to his old post, that of accountant in a large shop, his symptoms would promptly return, and progressive disease become re-established.
Instances of the successful treatment of Pulmonary Tuberculosis in England by the "open air method" might be multiplied ad libitum.

Although, for those whose means permit, a more genial climate than that of Great Britain, with mountain air, is to be preferred, it is obvious from what I have said, that both these conditions lose their special advantages without that strict attention to detail and rigid supervision, which should be the guiding principle of the treatment.

The case therefore of the poorer classes of Great Britain afflicted with consumption, is a distinctly hopeful one, and it is to be greatly desired that the time should not be far distant, when sanatoria affording gratuitous treatment, and conducted upon scientific lines, shall exist all over the country. The latest campaign against the scourge of Tuberculosis has commenced in earnest, and the unanimous opinion is—that unlike its predecessors, this—the most recent form of treatment, has come to stay.
South front of the Mundesley Sanatorium, Norfolk.

Shelter with moveable panels.
Note 1.

The Surgical Treatment of Pulmonary Tuberculosis appears to be not included in the scope of the Thesis. Neither are "Hydro-therapeutics".

Note 2.

The deleterious effect of wind and "draughts" in the "open-air treatment" to many languid & delicate are often due to hypodermic exposure to such. Below is seen a cheap shelter devised by Banting

Shelter made of painted canvas and light wooden frame.

The couch depicted is specially made and costs about £1.0.0.