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The Chemical Basis of Medical Climatology

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Chapter I

INTRODUCTION

PREMISE

SOMEDAY IT MAY BE possible to speak with precision and depth of the chemical basis of medical climatology, but this is certainly not possible today. Indeed, medical climatology, like climatology, is a natural science of a general character, if we do not confine it to the restricted field of traditional meteorology. Since it is a natural science of a general character, there can be no progress in climatology if there is no progress in those branches of knowledge which lie on the boundaries between climatology and other sciences – astrophysics, geophysics, meteorology, physical chemistry, biophysics, biology—and above all, if these fields have no mutual contact and penetration.

Nonetheless, it is worthwhile to attempt the laying of some kind of foundation if for no other reason than to have an idea of the type of construction we may erect upon it. The field of bioclimatology holds many surprises for whoever should choose to venture there.

I am not able to present a complete picture of the studies carried out to date in the field of bioclimatology, nor analyse the criteria upon which they are based. Even if I were competent to do so, it would be exceedingly lengthy and would not serve our immediate purposes. I will therefore confine myself to presenting certain examples to characterise the situation and to serve as a connecting bridge leading, in a logical and rational manner, to the part of the work in which I am at home: chemistry.

Nor will I cite studies or authorities in the field of bioclimatology. We have a great international organization, the International Society of Bioclimatology, with its center at Oegstgeest (Leiden, Holland). In addition, the American Institute of Medical Climatology has recently been founded in the United States.

Others, much closer to the subject than I, could speak more diffusely on events taking place in bioclimatological studies.

I view the resurgence of bioclimatological studies in the United States, due to the efforts of the American Institute of Medical Climatology, with great pleasure. One of the pioneers in this field was actually an American, Petersen, who left us with a fundamental work, *The Patient and the Weather*. But after his death, these studies slackened off in America while they flourished in Europe due to the works of De Rudder, Duell and others; too, there were created here numerous institutes within the framework of the great meteorological organizations: Deutscher Wetterdienst, Zentralanstalt fuer Meteorologie und Geodynamik (Hohe Warte Wien), Station Centrale Suisse de Meteorologie, etc.

MEDICAL CLIMATOLOGY AND TRADITIONAL CLIMATIC FACTORS

If, when we refer to medical climatology, we mean only the study of the forces exerted by traditional climatic factors upon the human body, we shall not be able to say any more than physical chemistry and physiology have been telling us for some time.

The traditional climatic factors are almost exclusively meteorological factors: temperature, pressure, humidity, wind, air masses, fronts, precipitations, the state of the weather and the meteorological situation and its evolution.

Those traditional meteorological factors which are measurable and therefore capable of being quantitatively evaluated and thus reduceable to numbers, are very few. Among these are temperature, pressure, humidity, etc.

No more than a summary description of the others is possible and their characteristics cannot be numerically determined; the evaluation of these factors is only qualitative.

Temperature, pressure and humidity are measured, one might say, wherever the relevant data may be obtained without difficulty. For air masses, or the meteorological situation, etc., one can always turn to meteorological bulletins.

MEDICAL CLIMATOLOGY AND GEOPHYSICAL FACTORS

In addition to purely meteorological factors we should also consider geophysical, electrical, electromagnetic, magnetic and gravitational factors:

a) Atmospherical potential, spacial electrical charge, electrical conductivity of the air, vertical currents, radio-activity of the air;

b) Electromagnetic waves or general disturbances of the electro magnetic field, terrestrial magnetism;

c) Radiation of various types;

d) Gravitational variations, and the effects of tides.

The electrical geophysical factors are only measured in a few scattered stations, mainly in the northern hemisphere of the earth, and these measurements are not always taken with continuity. Disturbances in the electromagnetic field are also measured in few stations and these generally record wave scales which differ from station to station. The data gathered are therefore of no current use to biologists. In fact, a biologist cannot use data in his bioclimatological studies which have been obtained 500 or 1,000 Km away, since electrical and electromagnetic disturbances differ at any given moment, depending upon the locality. Except in fortunate circumstances, the biologist wishing to examine the more important geophysical factors must install a complete range of equipment in his observatory.

The impossibility of gathering adequate information regarding these highly important factors renders a bioclimatologist's situation quite unsatisfactory, and it does not favor any advancement in our knowledge of these factors. We will see later how important certain of these geophysical factors are with respect to the studies in question.

EXTERNAL FACTORS AFFECTING BIOCLIMATOLOGY-BIOTROPIC FACTORS

The correlation of temperature, pressure, humidity and other factors which are measurable and reducible to numbers, with physiochemical and biological phenomena, although valuable information from a general standpoint, does not lead us to any fact which has not been noted previously in either physical chemistry or physiology, as I pointed out earlier. Furthermore, these correlations would not provide us with a complete solution to the effects of climatic variations. A simple example will illustrate this affirmation:

There are meteoropathic persons who, for example, display grave disturbances at the approach of a cyclonic zone, or even merely a low pressure zone. At such times, the person will feel the effects of the zone, even remaining indoors at a constant temperature. Therefore temperature is not an important factor. On the other hand, if the meteorological disturbance is not approaching, the person remains unaffected and can go upon a hill or a skyscraper with no harm accruing. Yet going to the top of one of the tall New York skyscrapers results in a pressure drop of around 30 mm of mercury. Nothing less than a common cyclone is able to provoke a similar pressure drop. But since there is no cyclone, the person remains unaffected. Therefore pressure is not an important factor. The same can be said of humidity.

Temperature, pressure and humidity thus have nothing to do with meteoropathic disturbances.

Is it worthwhile to continue considering these traditional physical factors in connection with modern bioclimatology? Probably not, except in a subordinate and auxiliary rôle, as long as variations in these factors are not indications of other concomitant phenomena which are of importance from a bioclimatological point of view. The traditional factors are not sufficient in themselves to define a biotropic situation and, considered alone, are of very little interest.

However other general factors are at work in the field of meteorology, such as the weather situation, the evolution of the meteorological situation, fronts and so on. It is not my place to speak in detail of these, but, as I see it, to identify, define and classify the factors in question in a clear manner that would be useful in biology and medicine is a very difficult job.

At some Institutes, in order to establish relationships between the meteorological situation and biological and medical occurrences, they have attempted to distinguish meteorological situations in a rough way, without dealing in minute details. They concerned themselves with descriptions which were largely qualitative. For example:

Dr. Ungeheuer had distinguished the meteorological situation in six phases:

Weather phase 1. Half fine-weather.
Weather phase 2. Improvement in fine weather.
Weather phase 3. Full fine weather reinforced eventually from *foehn.*
Weather phase 4. Beginning of clouding (break-up of weather).
Weather phase 5. Sky completely overcast (complete break-up of weather).
Weather phase 6. Beginning of improvement.

He then distinguished nine points in each phase:

1. General impression and tendency to evolve toward other phase
2. Clouding
3. Visibility, transparency of the air
4. Temperature and humidity
5. Atmospheric pressure
6. Wind at ground level and at altitude
7. Distribution of the temperature at altitude, inversion of the temperature at ground level
8. Electromagnetic wave disturbances in the field
9. Meteorological peculiarities, local clouds in the morning, dew, etc.

This classification in six phases with a description of the nine points was greatly appreciated and served as a basis for various studies of a bioclimatological nature (Muecher and others). This naturalistic and almost picturesque description of weather phases in fact permitted the correlation of the frequency of the phases with the frequency of certain biological phenomena. Thus we now know that weather phases are not without effect (indifferent) with respect to living organisms, at least in a general sense. But, of the mass of phenomena that constitutes a phase, what actually reacts upon the organisms?

In referring to the measurable factors—temperature pressure, etc.—we are reverting to the study of factors that have nothing to do with the phenomena which we should wish to study. Dr. Reiter, Director of the Bioklimatische Forschungsstelle of Munich, Bavaria, adopted a different method:

Instead of more or less minutely describing the meteorological situation, he concentrated on particular meteorological elements, taken as *meteorological indicators.* These indicators were chosen at random, with no pretense of doing anything absolute, but merely something useful and practical. Reiter holds that there must be a single causal dependence, valid under any circumstances, between the weather and the reactions of living organisms. It means distinguishing, on the basis of the indicators, the *biotropic situation* of the weather from the *non-biotropic situation.* This method makes it possible to know whether on a given day there were external factors at work capable of producing biological reactions. The principal indicators adopted by Reiter were:

a) *Atmospherics* (Infralangwellenstoerungen der Atmosphaere; VLF, *very low frequencies);* atmospheric disturbances on very long wave lengths—or *infra waves.*

b) *Any peculiarity in the atmospheric electrical field.*

Temperature, pressure and the other traditional meteorological factors fade into insignificance when compared with the indicators of biotropic situations. Even the other great factors, fronts, air masses, etc., seem to demonstrate the existence of a biotropic meteorological situation with less sureness and precision than do atmospherics and the static electrical field.

The effective and direct biotropic reaction of atmospherics was discussed at great length; however, later, after a wealth of observational material had been examined, highly satisfactory correlations between electromagnetic disturbances and certain biological and psychic functions were established (Curry, Duell, Linke, Moerikofer, Reiter, Schulze, Zink and others).

The electromagnetic field thus was established as a direct cause, as the determining factor in biological phenomena.

It is not within the scope of my work to deal with these problems. The examples which have been set forth clearly show how scholars in the field of bioclimatology are abandoning the traditional, typical climatic meteorological elements—those whose existence is physically discernable, in a direct manner, such as temperature and humidity—in order to adopt other elements, whose existence men cannot discern physically by the living organism, such as electromagnetic waves.

This is as to say that the climate will be modernly defined or, better, that the definition of climate will be enriched by new geophysical and astrophysical elemente.

THE CHEMICAL BASIS OF MEDICAL BIOCLIMATOLOGY IN THE PAST

If the basis that we wish to attribute to climatology is to be chemical, then before all else we should know what are the relationships between climatic and chemical phenomena. Once this is known, we should be able to transfer these relationships onto a biochemical plane and later onto a biological and medical plane.

Before going further I must point out that studies of this nature have only been carried out sporadically and have never been received with great favour.

Experimental chemists, analytical chemists and all those having to do with chemical operations, especially colloidal or any other type in a heterogeneous system, know that an indefinable *something* sometimes reacts on their operations. Even workers in certain branches of industry are aware of this. But these things are not discussed. Yet we are not speaking of negligible facts; for example, in some industries serious disruptions take place with frequency in correspondence with certain meteorological situations: in silk spinning, the making of some dyes, flotation and, in certain seasons, the application of magnesium cements. But these disruptions, which are truly inexplicable, are attributed either to chance errors (which is the handiest way of dismissing them) or to quirks in the system of handling, which lead to energetic measures to restore normal operations by modifying work conditions.

Colloidal arsenic trisulphide is widely considered as being sensitive to weather (*wetterempfindlich,* as the Germans say). E. Findeisen felt she had demonstrated the sensitivity of arsenic trisulphide using measurements of electrical conductivity, but Reiter sharply criticised this work. On the other hand, Wilke and Mueller showed that the sulphide in question is sensitive to an electromagnetic field. Recently, Neuwirth resumed the study of the influence of atmospheric phenomena on the *aging* of colloidal arsenic trisulphide by photometric means. The observations were conducted every day for two consecutive years and the author found that the discontinuities in the aging process were related to various atmospheric phenomena, among which were variations in the altitude of the stratum at 500 mb and cold fronts.

Calcium phosphate, precipitating from appropriate solutions, is also sensitive to external spacial factors and changes in appearance according to external conditions. It was Bortels who in 1951 first drew attention to this fact. Calcium phosphate from those particular solutions, in fact, precipitates in filaments and in flakes ~~in filaments~~ when the meteorological situation is anti-cyclonic, and in flakes when it is cyclonic, says Bortels. The manner of precipitation is influenced by a metal screen, for instance, a thin sheet of aluminum. It is even possible to observe the two types of precipitation in the same solution by covering the half of the vessel containing the solution with an aluminum sheet. From this it would seem that the modification in the appearance of the precipitate is due to disturbances in the electromagnetic field and that the appearance of filaments or flakes in correspondence with cyclonic or anti-cyclonic zones is still to be related with the electromagnetic phenomena which accompany the zones themselves.

The studies of the precipitation of calcium phosphate, begun in 1949, were carried out regularly each day at three fixed times, except for brief interruptions, for several years. Under the aluminum screen the precipitation occurs more often in the form of filaments than in the open. The explanation put forth by Bortels regarding this and other phenomena in which he referred to particular radiations or agents of low or high pressure (T-Agens and H-Agens), was strangely criticised; however, the facts which he presented are, in spite of the degree of uncertainty and the doubts to which they can give rise, the typical facts which are encountered by all those who wish to study these phenomena directly, relating the results of a given experiment to meteorological, geophysical or solar data. For this reason, Bortels' work is no less valid than that of other authors.

Bortels also studies a phenomenon of extreme importance from a general point of view: the freezing of over-cooled water. This phenomenon could not be more variable, and Bortels sought to link the frequency with which small samples of overcooled water freeze to the course of the weather.

An accurate statistical and critical analysis by Berg of the data presented by Bortels with respect to terrestrial magnetism and solar activity, came to the conclusion that the numerical data studied "barely succeeded in constituting a strong argument in favor of the 'pilotage' of the precipitation of calcium phosphate by terrestrial magnetism and solar activity." The results of Berg's highly acute criticism were, therefore, not negative, but sufficiently positive.

Bortels also studied the separation of water from agar gel, so-called *sineresis,* as related to external phenomena.

Bortels is to be highly credited for having indicated two typical phenomena as being sensitive to external factors: the precipitation of an inorganic compound and the transformation (passaggio di stato) of a pure substance. The pure substance is water, the home of the vital phenomena.

Neuwirth & Hummel studied the influence of meteorological factors on the dissipating power of colloidal solutions of Polyvinylpyrrolidon:

"Experiments on optical diffusion with a solution of Polyvinylpyrrolidon (Kolloidon k 30) have been carried out and have revealed exogen influence on the intensity of diffusion. The observed significant extremes were correlated with meteorological phenomena and shown to be in connection with fronts and horizontal shearing numbers. It followed also relation to the jet stream as to its position and time of arrival at the observation place. It seemed possible to use colloides as indicators for biometeorological or even for synoptical connection. The observed influence of weather on colloidal solutions may be explained by terrestrial or extraterrestrial electromagnetic radiation, more or less modified by weather influences. It could not yet be determined at which place in the wave spectrum the colloidal meteorological rays are situated, nor was it possible to find anything definite concerning the character and kind influencing the colloidal solution."

Caroli & Pichotka studied the influence of the weather on the results of titration of sodium thiosulphate. The condition of the experiments shows that the cause of the variation of titration results may consist in changes of electromagnetic undulatory radiation of high frequency or in radioactive radiation.

To the purely chemical studies listed above we must add a study that provided one of the most spectacular examples of spacial influence on a chemical-biological system: Takata's report, one which is well known in medical circles.

Since 1941, Takata & Murasugi have established that the flaking numbers of the blood serum of a healthy man (Takata's numbers) remain very constant over a period of time. But in certain periods these numbers can rise to very high values, suddenly or even tumultuously. The disturbed periods for Takata's reaction were those between the years 1938 and 1943 and between 1948 and 1950. These were not local phenomena; rather they were worldwide. Takata's reaction was in current use in clinical practice all over the world and, because of its wide adoption, it must be considered a wonderful test. Simultaneous disturbances and parallel behavior patterns were observed in localities as much as 1500 Km apart.

The disturbances in Takata's reaction were related not to meteorological phenomena, but to solar phenomena. The passage of a group of spots along the central meridian of the sun seemed to disturb Takata's reaction. But the phenomenology observed in great profusion in the years 1938-1943 and in lesser profusion in the years 1948-1950 was never again evidenced. The disturbed periods indicated by Takata's reaction correspond to the diminishing (or to part of it) of the two solar cycles which preceded the present one, whose maximums of activity were recorded in 1937 with an average of 114 spots, and in 1947 with an average of 150 spots daily. It would be extremely interesting to know what is taking place today, now that we once more find ourselves in the diminishing phase of the present solar cycle, which reached its maximum of activity in 1957 with an average of 190 spots, the highest ever registered!

The behaviour of Takata's reaction awoke great interest and many scholars studied it with a view to possible relationships with solar or geophysical phenomena. But in spite of all the studies that were carried out, it was not possible to clarify completely the situation. The problem remained open, but there was no doubt that the disturbances indicated by Takata's reaction are of spacial and, above all, solar origin.

These studies, in which a connection was sought between the the chemical and biochemical phenomena which take place in surrounding space, are extremely noteworthy. As far as I know, literature on the subject does not offer a great deal more. As one can see, the number of studies carried out has been scanty, even though some were very painstaking. This is not, unfortunately, a subject which interests chemists at this moment. The greater part of the studies outlined above are the work of persons outside the chemical field.

I do not wish to enter into an involved discussion of the results obtained by the various authors. It must be admitted that these results are acceptable as being more indicative than definitive. In fact, the simple and direct correlation of chemical or biological-chemical events with spacial events provides a glimpse of an appreciable interdependence between these two orders of phenomenon, without introducing new criteria or methods.

A MODERN CHEMICAL BASIS

However, we are still not coming to grips with the chemical problem. What external forces are at work, and how do they react upon a chemical system? What is the sensitive part of a chemical system?

These are the questions upon which I personally have concentrated during the past ten years.

In closing this introduction, I must of necessity mention the research which I began in 1935 and which has continued up to the present, on a particular phenomenon known as the "activation" of water. The term activation is exceedingly ill-chosen, but by now it has established itself in usage.

By means of particular physical procedures, it is possible to modify water physically without modifying its chemical composition or the traditional physical conditions in which it is found:

temperature, pressure, illumination etc. These procedures, all of them empirical, have been the subject of many industrial patents. These patents have been employed in the physical descaling of boilers, water reservoirs etc. The instruments for the activation of water do not give constant results over a period of time and often display anomalous behaviours.

In order to study the phenomenon of "activation," I conceived a differential method by means of which I was to compare the behaviour of one sample of water in an activated and in a non-activated state. I noted that the physically modified water did not always produce the same effects; the effects were of one sign during a given period of time, and of contrary sign during another period, without anything apparently having changed. This was the point upon which I concentrated, and in 1938 I became aware that *these changes were related to external phenomena,* not at that time clearly identified. In 1939, I announced that I had been correct in assuming that certain chemical phenomena were subject to the actions of spacial phenomena, and I invited chemists, biologists, meteorologists, to collaborate with me in this new research. But the proximity of the war interrupted my work and I was not able to resume it until 1950 at the Institute of Physical-Chemistry of Florence University.

Many chemical systems were studied during this period, all of them *heterogeneous systems in evolution:* precipitation of oxichloride of bismuth by means of hydrolisis; precipitation of colloidal arsenic trisulphite; precipitation of silver halide, of calcium sulphate, formation of colloidal gold by means of reduction of chloride etc., and also the simple deposition of inorganic compounds in water: graphite, mercury oxide etc.

During this long series of studies, which was highly promising but not very conclusive, I was able to ascertain at one point—in 1936—that a metal screen was sometimes capable of modifying the direction of activation: for example there was a passage from activation which accelerated precipitation to activation which retarded it.

This fact confirmed that water is a sensitive substance to external actions and that it is enough to modify these conditions with a metallic screen to note an effect. A thin metallic screen changes the electric field and the electromagnetic fields at least in part. But even these were only indications.

The work carried out from 1935 to 1940 is to be considered as a broad exploration in search of bridges to connect an extremely vast complex and general network of phenomena, so general that the chemical quality of the material involved *was not so important as the aggregate state of the material* and evolution of this aggregate state in the course of time. More than being merely chemical, the research was physical-chemical. The externally-acting phenomena could be studied using any material providing that material was in a suitable aggregate state which had not reached a state of equilibrium and was still in evolution. The basis of these phenomena seems structural.

Basically, these old studies still partially possessed characteristics of the research carried out later by other authors. *Heterogeneous systems which are not in equilibrium, especially colloidal systems, are the indicators of an external situation.*

The studies of "activation" showed that water is by itself an easily-influenced body. In fact, physical processes modify it in a semi-permanent manner, in the sense that the modification persists for a very long time. This permits the storage of industrial water after treatment and thus the utilization of instruments which are compared to the quantity of water treated.

Water is, therefore, a sensitive and modifiable body. I have shown that modification is possible in water prepared for conductance measurements (equilibrium water), in normal distilled water, in drinking water from a tap, as well as in dirty water from a brook or river. The behaviour of one of the reactions I have mentioned differs if normal or activated water is employed together with the same chemical reactive. There is no need to underline the importance of this fact: it is well known that life takes place in an aqueus and colloidal system—that is, in the type of system studied by myself and by the other authors.

For this reason, after having shown how external phenomena influence aqueous colloidal systems, I have concentrated on the study of the structure of water, which I shall shortly describe.

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