SHORT-
and
LONG-TERM
CHANGES
in
CLIMATE

Volume I

Felix G.Sulman

Short- and Long-Term Changes in Climate

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PREFACE

The contents of this book, *Short- and Long-Term Changes in Climate*, are the result of interdisciplinary studies carried out by a 15-man team which has worked together for 20 years. We would like in particular to mention the devoted collaboration of Drs. M. Assael (Psychiatry), A. Danon (Pharmacology), S. Dikstein (Pharmacology), N. Hirschmann (Biochemistry), Y. Kaplanski (Endocrinology), Y. Koch (Endocrinology), D. Levy (Electronics), A. Lewy (Statistics), L. Lunkan (Electronics), I. Nir (Pharmacology), Y. Pfeifer (Biology), B. Shalita (Biology), E. Superstine (Pharmacy), E. Tal (Pharmacology), J. Tannenbaum (Electronics), and C. P. Weller (Pharmacology).

The topic of biometeorology and paleoclimatology is so fascinating that new research students are attracted to it every year, and the circle is growing steadily. This is, in fact, part of a much more extensive research field which has culminated in the development of a Bioclimatology Unit in our department. It all started from the senior author's experience and interest in diseases of man and animals and the wish to alleviate their sufferings. Thus, pharmacology and therapeutics became our main field of work since 1934. However, the exigencies of changing climates in Israel demanded our daily attention.

Our work in this sphere was initiated by a generous grant from the Florina Lasker Fund for the Research of Man in the Holy Land, administered by Professor Kalman J. Mann, Director of the Hadassah Medical Organization who is still the chief promoter of our work. Our research was also assisted by Professor A. Kreiser, Associate Dean of our Pharmacy School. During the course of the research, the U.S. Department of Health, Education and Welfare, through its branch of Environmental Health Services, helped our studies by Agreement # 06-005-3, administered by Dr. A. Henschel, Cincinnati. At a later stage the U.S. Office of Aerospace Research helped us with a considerable grant. Then, during the period of recession we were supported by the Amcor-Amron Co. of Tel-Aviv through the kind offices of Mr. S. Goldman. Special thanks are due to Dr. Y. Pardo and his wife, Hanita, who took it upon themselves to help us with advice and resources. For the last several years our Bioclimatology Unit has enjoyed the magnanimous patronage of Mr. Herman and Mrs. Elsie Lane, New York, whose generous help has made the present work possible.

Special thanks are due to Miss Yocheved Sussmann, who has been editing and proofreading our papers for many years past, and has now devoted again her untiring effort to putting this book into proper shape.

Mrs. Sylvia Farhi deserves our admiration and gratitude for having carried out the difficult work of typing the manuscript with great zeal and devotion.

Finally, we wish to thank Mr. B. J. Starkoff, President of CRC Press, Inc. and his staff, especially Mrs. Lisa Levine Eggenberger, for all their invaluable advice and guidance.

As this monograph contains mainly some guiding references connected with the impact of climate changes, the reader who wishes to have a biometeorological survey is referred to the standard books in this field: S. W. Tromp, *Medical Biometeorology* (1963 and 1980)[1] and *Progress in Biometeorology* (1963 and 1973).[2] The controversial topic of paleoclimatology has been exhaustively described by H. H. Lamb in *Climate — Present, Past and Future* (1972 and 1977).[3] German readers will find valuable information in the survey *Biometeorologie* by V. Faust (1977),[4] in the monograph *Unsichtbare Umwelt* by Herbert L. Koenig and S. Lang (1977),[5] and in H. Flohn, *Klimaschwankungen* (1963, 1969).[6]

Recent climate events, such as droughts in Africa and India, and a decline in rainfall affecting many other countries, have emphasized that climate can change rapidly and such changes can become important to human affairs and migration of nations. This

is the message conveyed to us by the paleoclimatology chapters in Volume II.

Weather is something one has to live with. In many countries it is a universal topic of conversation — and rightly so. John Heywood, 1497—1580, a contemporary of Henry VIII, known as a dramatist and an epigrammatist, wrote a charming comedy "Play of the Weather". He called it "A New and Very Mery Enterlude of All Manner Wethers". The farce describes a worried "Jupiter" who has been implored to abolish the wanton machinations of "Saturne" producing cold, "Phebus" sending heat, "Eolus" governing the winds, and "Phebe" launching the rain. Hearing the complaints of eight witnesses, Mery-Reports the Vyce, Gyntylman, Marchaunt, Ranger, Water Myller, Wynde Myller, Gentylwomen, and Lannder, he soon learns that everybody wishes another type of weather to suit himself. Jupiter feels that he cannot give in to the whimsical demands of each claimant and, after much litigation, decides that the case should be dismissed with costs. Thus, everything returned to the status quo and has remained so ever since.

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INTRODUCTION

Scope of Climate Research

In recognition of the manifold ramifications of climate research the International Society of Biometeorology was founded in 1956 with headquarters in Oegstgeest (Leiden), The Netherlands, under the secretariat of Dr. Solco W. Tromp. It now consists of over 500 scientists from varying disciplinary backgrounds from over 50 countries. Within the society there are nine permanent study groups devoted to the following topics:

1. Effects of Heat and Cold in Animals and Man.
2. Effects of Weather and Climate on Human Health and Disease.
3. Effects of Weather and Climate on Animal Disease.
4. Effects of Weather and Climate on Plants and Trees.
5. Architectural, Urban, and Engineering Biometeorology.
6. Biological Effects of Natural Electric, Magnetic, and Electromagnetic Fields.
7. Physical, Physiological, and Therapeutic Effects of Ionized Air and Electroaerosols.
8. Biological Rhythms with Special Reference to Environmental Influences.
9. Physicochemical and Biological Fluctuating Phenomena.

Out of this awe-inspiring list the topics listed under numbers 1, 2, 5, 6, 7, 8, and 9 will be dealt with in the present monograph.

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THE AUTHOR

Professor Felix Gad Sulman was born and educated in Berlin. He is presently Professor Emeritus of Applied Pharmacology at the Hebrew University of Jerusalem. He holds doctorates of Medicine and of Veterinary Medicine from the University of Berlin, Germany. His specialties include Pharmacology, Endocrinology, and Laboratory Sciences in which he has worked since 1930.

He is a member of many scientific societies including the Society for Endocrinology and the Royal Society of Medicine, U. K.; the Endocrine Society, Society for Experimental Biology and Medicine, and the New York Academy of Sciences, U. S.; the International Society of Biometeorology and the American Institute of Medical Climatology.

Dr. Sulman is the author or co-author of over ten monographs. In addition, he has published over 500 scientific papers in collaboration with his assistants, and is an Honorary Member of the Sociedad Argentina de Farmacologia y Terapéutica.

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HISTORY

I. SHORT-TERM CHANGES OF WEATHER AND CLIMATE

A. Introduction

1. Technical Terms

In everyday language *climate* and *weather* mean such qualities as wet or fine, warm or cold, and until perhaps 100 years ago these descriptive terms were adequate for most purposes. Since the growth of Earth activities, however, the weather factor has become more significant economically, and weather study has been put on an organized and scientific footing. Instead of descriptive terms, standardized terms are used. These apply chiefly to those factors which are measured by instruments and specified numerically — like winds, air electricity, temperature, sun radiation, and rainfall — but also to some other factors like cloudiness and fog. The branch of science concerned with climate and weather is called *meteorology*.

The Earth is enveloped by a vast ocean of air, called the atmosphere, at the bottom of which lives man. The total depth is about 150 km, but at great heights the air is very thin, so that half the weight of the atmosphere is contained in the lowest 5 km. This lower region is in a state of constant turmoil, the varied effects of which are recognized as weather, and its impact on a given locality is called *climate*.

2. Definitions

Biometeorology and *bioclimatology* are similar conceptions defined as early as 150 years ago by Alexander v. Humboldt (1769 to 1859). They are the study of the direct and indirect mutual relationship between the geophysical and geochemical surroundings of the atmosphere and living organisms.

Biometeorology thus embraces the reactions of man and animals to the meteorological events in our surroundings, and bioclimatology describes the influence of the climate of a given place on human and animal health. The latter thus depends on the localization of a settlement. Currently, its major emphasis is upon: (1) the heat balance of the human body under different conditions of air temperature, humidity, and wind; (2) the effects of radiation, especially electromagnetic, nuclear, ultraviolet, radiation which affect general health; (3) the effects of atmospheric composition and of types and changes of weather and climate on human health, vigor, and disease; and (4) the effects of electrical conditions, including air ionization, electric fields, and atmospherics (Figure 1).

3. General History

Biometeorology or bioclimatology, the science of studying the influence of weather and climate on the living organism, is a young and at the same time a very old science — young by scientific standards, old if we consider the strong belief of man, from earliest historic times to the present day, in the great influence of weather and climate on man's behavior and happiness and on the origin of his diseases. Winds and the impact of the electricity created by them play the main role in this field.

Prehistoric man understood very little of the winds, but his discovery of clothing, shelter, and fire shows that he realized his vulnerability to the weather. Without these amenities, he was restricted to the milder area; with them he could survive in harsher conditions. The desire of man has always been concentrated on three points: life convenience, adequate food, and energy for heating.

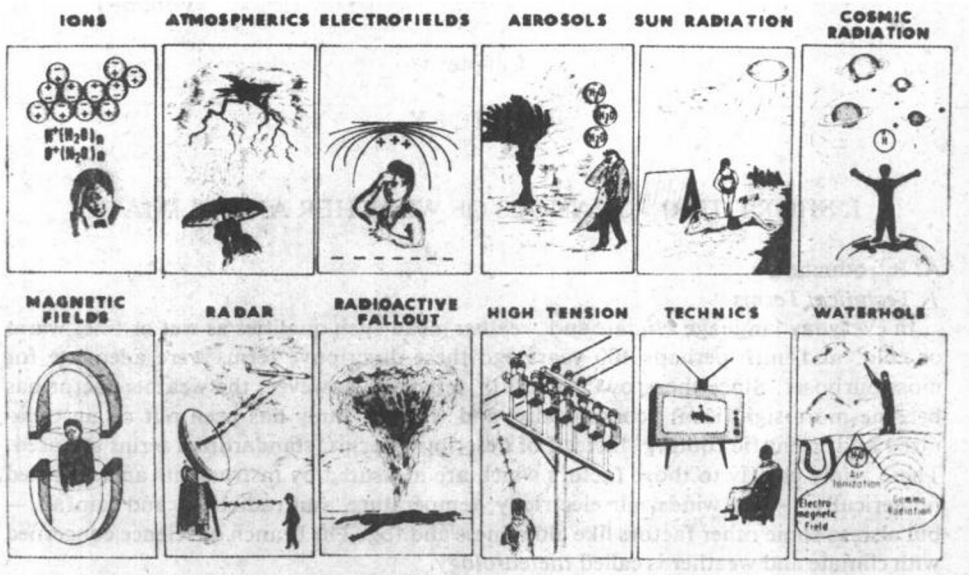

FIGURE 1. Twelve sources of air electricity and their impact on climate. (1) ions, (2) atmospherics, (3) electrofields, (4) aerosols, (5) sun radiation, (6) cosmic radiation, (7) magnetic fields, (8) radar microwaves, (9) radioactive fallout, (10) high tension, (11) technics radiation, (12) waterhole effects (dowsing). (From Sulman, F. G., *Health, Weather and Climate*, S. Karger, Basel, 1976. With permission.)

4. Ancient History — Wind Directions in Ancient Mesopotamia

According to Neumann,[1] the ancient Mesopotamian civilizations (Sumer, Akkad, Assyria, and Babylonia), reaching back to before 3000 B.C., did not develop or possess the notion of the "cardinal" astronomical directions — N, E, S, and W — until the relatively late date of about 700 B.C., in contrast to the Greek and Hebrew civilizations of antiquity. Instead, orientation was determined by the directions of four principal winds — namely the "regular wind", the "mountain wind", the "cloud wind", and the "Amorite wind". In terms of our notation, these could be described as, respectively, a NW, a NE, a SE, and a SW wind, or as winds from the northwesterly, the northeasterly, etc., quarters. Even astronomical features were indicated (mainly before 700 B.C.) in terms of the directions of the principal winds. In the Assyro-Babylonian language the same word designated a principal wind and the direction from which that wind blows.

Judging by inscriptions and other finds of archeological excavations, the most prominent wind was the "regular wind" (NW wind), probably because of the high frequency of the wind (it is certainly by far the most frequent wind direction in the present era). Maps and city and topographic plans were usually oriented so that the NW direction was "at the top", as N is on current maps. Several of the royal inscriptions say that the walls of the city (often of a rectangular shape), as well as the streets of the city were "opened" to the four winds. These statements are corroborated by the archeological excavations. It seems likely that the orientation was chosen so as to take advantage of the heat-stress-alleviating effect of winds.

The ancients often considered diseases to be due to possession by winds. Incantations were used to treat people seized by such demons. In one Mesopotamian incantation (4000 to 3000 B.C.), Tiu, the evil spirit of headache, has attacked a victim:

Headache roameth over the desert, blowing like the wind, Flashing light lightning, it is loosed above and below; It cutteth off like a reed, him who feareth not his god.

Before the dawn of science, those who were sick believed their troubles were caused by the gods, who were identified with winds, planets, and stars. This fatalistic approach was an obstacle to medicine for centuries. Life, as opposed to death, was associated with breathing air, though air itself was a mystery. Some diseases arrived with one season; others, with another. Cold, rainy spells were followed by a certain type of sickness.

In other early times, clusters of stars, the zodiac, were related to parts of the body, and were used in the treatment of disease. Priests and physicians of many early cultures — the Chaldeans, Egyptians, Babylonians, and Assyrians — watched the sky for implications of sickness. One early text said, "If the constellation of Cancer becomes obscured, a fatal demon will possess the land and many deaths will occur."

Ancient China was not without its weather-oriented medical philosophers. Examples of Emperor Huang Ti's thinking in 2650 B.C. are heat impairs the heart, cold impairs the lungs; the west wind is bad for the heart, breast, and ribs; the north wind is bad for the kidneys and hips.

India's Susruta in 600 to 500 B.C. popularized health resorts by recommending that the king go to a dry locality during the dangerous rainy season.

5. Classical History

Greek science took another view. Pythagoras (580 to 489 B.C.) believed that incorrect proportions of the four elements — fire, earth, water, and air — caused sickness. A little later, Empedocles was given credit for preventing an epidemic in Sicily. He is said to have prevented a "miasma" from entering the city by sealing an opening in the mountains nearby.

Hippocrates' (460 to 377 B.C.) writings are a major turning point in attributing disease no longer to supernatural but to natural causes, even though the latter were misunderstood. He said that to investigate medicine properly, one should consider the effects each season of the year produces. Then he suggested to consider the hot and cold winds, local ones as well as general ones (Figure 2). His advice to travelers upon reaching a strange city was to notice the orientations with respect to the wind and sun. This would tell them what epidemics would strike the city in summer and winter. In his "Aphorisms" there are lengthy statements of the effects of season and winds on health. An example, "South wind induces dullness of hearing, dimness of vision, heaviness of head . . . But if the North wind prevails, cough, afflictions of the throat, . . . occur." Hippocrates remained largely in favor for 2000 years. In his book *Airs, Waters, Places,* he made the following interesting statement:

> Whoever wishes to pursue properly the science of medicine must proceed thus. First he ought to consider what effects each season of the year can produce: for the seasons are not alike, but differ widely both in themselves and at their changes. One should be especially on one's guard against the most violent change of the seasons, and, unless compelled, one should neither purge nor apply cautery or knife to the bowels, until at least ten days have passed.

When the Greek and Roman civilizations were at their zenith, important political decisions were not carried into effect and war campaigns were often postponed until the weather gods had been consulted.

In the Temple of Aeolus, the God of Winds, in Athens, an impressive marble octagonal tower was built, the eight sides of which represent the eight classical winds (Figure 3):

- Boreas, blowing from the north
- Kaikios from northeast
- Apeliotes from the east

FIGURE 2. Aeolus, God of the Winds. Anonymous picture in the Piccolomini Library at the Dome of Siena. (From Sulman, F. G., *Health, Weather and Climate*, S. Karger, Basel, 1976. With permission.)

- Euros from southeast
- Notos from the south
- Lipos from southwest
- Zephiros from the west
- Skoros from northwest

On each side is sculptured a human figure, symbolizing the character and influence on man of the particular wind it faces. Iphigenia was the victim of such an unfavorable wind.

Writers in the next several hundred years came up with other ideas. Celsus (25 B.C. to 50 A.D.) advised sea voyages and new climates for treatment of sickness. Mountain climates were advocated by Galen (130 to 200 A.D.), who claimed also to find a difference in the strength and resistance of infants born in certain phases of the moon.

6. Significance of Winds in Warfare

Neumann and Metaxas[2] reported in 1979 that in summer, 429 B.C., the third year of the Peloponnesian War, a sea battle took place in the Gulf of Patras between 20