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*Meteorological Phenomena and Climate in Byzantium*

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SUMMARY

The increased awareness of man's susceptibility to the vagaries of climate has led during the last decades to a widening international cooperation for the reconstruction of climatic change in historical time. Though many scientists have contributed since the late nineteenth century to the history of European climate, no serious attempt for making use of climate-related information hidden in Greek medieval historical sources has been made so far. In 1987 the Department of Physics at the University of Ioannina (project leader: Professor Dionysios Metaxas, Meteorology) in cooperation with the Historical Department at the same University (under the scientific supervision of Professor Evangelos Chrysos, Byzantine History), joined an EEC project [Contract EV-0028-GR (TT)] on "*The Reconstruction of past Mediterranean Climate in Historical Time*". As a member of the historical team, I undertook the investigation of the full range of the relevant material hidden in some of the most significant genres of the Byzantine narrative sources. This book is fruit of that research and was submitted as doctoral thesis for the degree of the Doctor of Philosophy in the Department of History and Archaeology at the University of Ioannina in early 1995.

In this study an attempt is made to survey the most informative genres of the Byzantine narrative sources, to collect, organize, and evaluate all direct and indirect records concerning meteorological phenomena and climate, and then analyze the available information. The aim was:

- i. to investigate the material from a purely historical point of view, dealing with subjects relevant to the relations between man and climate in the Byzantine period (i.e. human perception of climate, human response and adaptation to climatic shifts etc.)
- ii. to correlate the documentary paleoclimatic evidence with the indirect physical evidence for the history of climate (proxy data).

The book consists of four parts.

Part one is an extensive introduction to the subject. Critical methodological information is presented concerning Historical Climatology, i.e. the sub-discipline of Paleoclimatology that copes with climatic evidence available from written materials of the past, particularly for periods prior to the era of instrumental meteorology (17th century for the most European countries). Classification of the sources for Historical Climatology, as well as methodological observations on the difficulties coherent in the various genres and types of the written sources and the trustworthiness of the climatological information deriving from them, are generally outlined (chapter A.1).

In chapter A.2.1 I briefly discuss the methodological problems regarding the impact of climatic change upon Medieval societies. After a discussion of various topics (i.e. sufficiency of climatic data for climate reconstructions, identification and measurement of the impact through the construction of preliminary models representing the expected links between climate and human affairs, and comprehension of the way in which people perceived and adapted to climatic phenomena, stresses and changes), I conclude that the complex interrelationships between biospheric variables and social affairs make the detection of climatic impact extremely difficult. The attempt to detect linear interrelationships between climatic variability and socio-economic affairs has led some scholars to simplistic approaches (climatic determinism).

In chapter A.2.2 I focus upon Eastern Mediterranean and the Middle East during the Byzantine Era (300-1500 A.D.), according to the geographic and chronological limitations of my research. A review of the recent paleoclimatic, historical and archaeological bibliography proves that little

interest concerning climate-related records has been given so far by byzantinologists and other scholars. The approach of the climate-related documentary records from the Byzantine sources is fragmentary, and has been used mostly as additional testimonial material for political/economical cases of study. In contrary, issues relating to the impact of natural and specifically meteorological phenomena upon the conscience and the mentality of the Byzantine man have been analyzed in more systematic way. This has happened because of the orientation of the researchers to the analysis of the evidence in its eschatological context taking as critical parameters the pagan and superstitious beliefs of the Byzantine man as preconceptions in the comprehension and perception of natural environment.

In the second part of the book an extensive *corpus* of the documentary records deriving from numerous narrative sources is presented. The fieldwork of sources and information covering the aims of the present research, as well as the geographic and chronological framework of the research, are defined in chapter B.1. The existing lack of works on documentary material for the history of Eastern Mediterranean and the Middle East climate is highlighted and interpreted.

As regards to the sources I surveyed, they belong to the most informative genres of the Byzantine narrative sources for the purpose of such a research:

- i. The actual historical writers such as Ammianus Marcellinus, Zosimus and Procopius or the later Michael Psellus, Anna Comnena or Ioannes Cantacuzenus etc.
- ii. The chronographers who write universal chronicles starting from the Creation of the World up to their days, such as Ioannes Malalas, Theophanes Ioannes Zonaras etc.
- iii. The church historians such as Eusebius, Socrates, Euagrius or Nicephorus Callistus Xanthopulos etc.
- iv. Saints' Lives (*Vitae Sanctorum*) of the Byzantine Church such as Vita Pachomii, (4th century), Vita Melaniae (5th century), Vita Niconis (10th century), Vita Maximi Causocalibitae (14th century) etc.

I excluded from my research theological texts, collections of letters, papyri etc., because the climate-related records that these genres of sources might contain, appeal to more sparse and less concrete meteorological evidence than the other genres of narrative sources. Furthermore, I investigated some historical writers and chronographers belonging to adjacent lingual and historic-geographic oriental cultures (e.g. Arab, Syrian, Armenian historians and chronographers the work of whom could be found in translation to some European language). This happened because the material gathered from the Byzantine sources could be crosschecked and enriched with additional material from these non-Byzantine -but chronologically and geographically parallel- sources.

As regards to the types of information that I sought in the sources, I collected all testimonies on weather, climate and phenomena indirectly related to them (severe winters, droughts, rainfalls, hail falls, storms, floods, food crises etc).

In the second chapter of Part two (B.2) I present the collected documentary records in database form. All records were encoded, correlated and validated through the application of various historic-philological research-criteria (evaluation of authors' reliability and information's authenticity). The database is in chronological order. When there are descriptions on a particular event recorded by more than one author, all descriptions are presented under the same code-number according to each author again in chronological order. The relevant fragments of the prototype texts are also presented literally. Over 700 records containing one up to ten pieces of evidence each -from about 166 works (1083 pieces of evidence in sum)- are presented.

On the basis of a systematically established database of phenomena related to climate, I attempt in Part three to subject the obtained information to rigorous qualitative elaboration and quantitative analysis. In chapter one of Part three (C.1) I investigate the form and the content of the evidence (language, style, possible philological motivo' s) and establish the meanings of words

and categories as well as the nature of authors' biases. Relying on the assumption that the authors, either contemporary to the events they describe or compilers, report what they find most interesting and significant or think their audience would find so, I examine each piece of evidence in comparison to a maximal list of expected meteorological features.

Though it is hard to generalize, a glance at that comparison suggests that the Byzantine authors approached meteorological phenomena as curiosities or marvels mirroring the Divine Will. In most cases the aim of the authors -especially of the chronographers- is to demonstrate the steady and powerful interference of God in the development of human history under a concrete eschatological scope. Because of this, they present the events as God's acts of educational punishment of His people. This theological internal meaning of natural events did not prevent the authors from emphasizing on the consequences of such phenomena upon material and social life. The Byzantine historian, chronographer or biographer was not concerned about the physical explanation of meteorological phenomena. He did not also go to great lengths to define them in terms of time and space, because he was more interested in reporting their material consequences and supernatural interpretation. More concrete in terms of time and space were the chronographers, because of the annalistic pattern of reporting they employed. The tendency of reporting damage on buildings and casualties (deaths and injuries) is more remarkable rather than the reporting of the experiences and reactions of those affected by the event. Some interest in the meteorological phenomena as links in the chain of military events can be determined in the work of historians. It is difficult to pattern the thoughts, the feelings and the way in which the Byzantines perceived the phenomena and the changes of natural environment; especially when the way to this understanding passes through the investigation of sparse and fragmentary accounts hidden in various texts. The available evidence is biased towards the record of extreme events and not of systematic observations.

In the second chapter of Part three (C.2) I proceed to a statistical analysis of the sources and the obtained data, in order to quantify them and construct a time-series of climatological elements.

The general impression that one retains from the statistical elaboration of the sources in century scale, is that for the 4th to 12th century A.D. more than 15 sources per century provide information in contrast to the 13th and 15th centuries with less than 8 sources. As regards to the genres of the sources, Chronography provides the best chronological cover in contrast to Saints' Lives. The most inclined genre of sources to reporting meteorological accounts is Chronography with an average of 11.6 pieces of evidence per source. Historiography averages at 6.5 and Saints' Lives at 2.4 pieces of evidence per source. In no century a remarkable increase of the amount of the sources could be observed. The estimation of the geographical dispersion of the information suggests that most information concerns Asia Minor, Mesopotamia and Constantinople, which was the capital of the Byzantine Empire and the cultural center of Byzantine mental life.

The statistics of the data-series' climatological elements (in table form appears in chapter C.2.2), does not encourage sophisticated and ambitious climatic reconstructions. From a purely quantitative point of view, I cannot claim that the product of my research is satisfactory. The direct meteorological evidence which provides data on changes in temperature or humidity -adequate for quantification in terms of standard meteorological variables and for constructing meteorological time series to introduce long-term fluctuations- is not systematic but fragmentary. Though this step of my research seems to be hopeless as the data are highly sparse, discontinuous, non-homogeneous, and thus non-quantifiable, the whole task is far from meaningless.

Using descriptive quantitative methods of analysis, and approaching the material on the basis of wider geographic and chronological scales (in 50- and 100-year scale), some climatic indications are discernible. The climatic variables that attract the interest of the sources (temperature / rain), are those of coldness and dryness. More indications of coldness can be observed for Constantinople, Asia Minor, Armenia and Mesopotamia during 1000-1350 A.D., as well as for

Thrace and Macedonia during 1250-1400 A.D. Indications of wetness are comparatively more for Asia Minor, Armenia and Mesopotamia during 1000-1100 A.D. Dry spells appear more common during 300-400, 500-750, 1150-1200, 1250-1300 A.D. for Egypt, Palestine, Syria, and Cyprus, as well as for Constantinople, Asia Minor, Armenia and Mesopotamia during 500-600, 800-850, and 1000-1050 A.D.

In the last, fourth Part of this book I attempt to compare the imperfect and quite broad framework of climatic fluctuations, shaped by documentary material, to already existing indirect data derived from physical materials (proxy data: tree-ring records, pollen records, glacier fluctuations, lake levels etc.).

The investigation of the bibliography, based on this type of data concerning Eastern Mediterranean and the Middle East during 300-1500 A.D., proved that the relevant climatic reconstructions are also imperfect. Systematic and homogeneous research on various types of proxy data (especially pollen and tree-ring for Eastern Mediterranean and the Middle East) is still desirable. Although, from the already existing data, some comparison is possible, quite impressionistic and empirical in deed, to the conclusions based on the documentary evidence. From this comparison, a general picture can be shaped. The main climatic trend for the centuries 4th to 7th A.D. seems to be drought. The period 8th-13th centuries A.D. was, more or less, colder and wetter with some dry intervals. During the 14th and 15th centuries the high levels of precipitation continued while temperatures moderated somewhat.

A final observation must be made on the history of climate for Eastern Mediterranean and the Middle East during the Middle Ages. The problem of the chronological and geographical assessment, but also of the size and the results of climatic change for the given wide area and period is still open. Documentary evidence has its own limitations while data are sparse, discontinuous, non-homogeneous, and non-quantifiable. It is difficult to pattern the thoughts, the feelings and the way in which the Byzantines comprehended and perceived the phenomena and the changes of natural environment; especially when the way to this understanding passes through the investigation of scanty and fragmentary accounts hidden in various texts. Proxy physical data are also imperfect. Collection of more data is the only way to remove imperfections. The growing evidence for climatic patterns of the Byzantine Era will perhaps cast new light on problems in economic and social history.