

INTRODUCTION

Historians of climate can be ranged for the most part in one of two categories, according to their intellectual origins. Some, like Bryson, Fritts, Lamb, Mitchell, and Von Rudloff, are experts in the natural sciences: biologists, or more often meteorologists, they quite naturally want to complement the knowledge and explanation of present-day climate, which both limits and delimits their colleagues' researches, with another dimension stretching back into the past. Honor where honor is due: these scholars have been able to adduce new and far-reaching ideas on the physical causes of, and major variations in, climatic change.

But the contribution of a second group of researchers is equally irreplaceable. This group consists of geographers, archaeologists, and professional historians whose specialization in economics or demography brings them in contact with old archives, either documentary or archaeological, concerning climatic events. Thus Gustav Utterström, starting from the analysis of agricultural conditions in eighteenth-century Sweden,¹ has been able to give an account of climatic fluctuation in modern Scandinavia, showing that the exceptionally mild winters in Sweden between 1721 and 1735 had a beneficial influence on the sowing of grain, pasturing of cattle, employment, public health, and longevity. He is also able to show this momentary mildness of the Nordic winter, as one of the factors in the great leap forward in the population of Sweden in the 1720s and 1730s. In England, dealing with a much earlier period, the medievalist John Titow, using the manorial accounts of the see of Winchester, has been able to draw up an outline of the incidence of bad weather which is of cardinal importance for our knowledge of climate in the West during the thirteenth century.

Like Utterström and Titow, I belong to this second group, his-

torians who burrow among archives. It was in fact the history of agriculture that led me, by a logical and even inevitable transition, to the history of climate. Twelve or so years ago I was studying, through archives and registers, the history of certain groups of French peasants in the sixteenth and seventeenth centuries.² As is usually the case, the documents were extremely informative about the chronology of climate: meteorological references to severe winters and wet summers accompanied all the records of poor harvests, famines, shortages, and occasionally years of abundance. The country dwellers of traditional societies were constantly at the mercy of climatic benediction or calamity. But, fascinating as these descriptive documents were, in themselves they did not enable one to throw much light on contemporary meteorology. The handwritten comments on climate from some parish register, or the worm-eaten and illegible records of some lawyer, were too accidental and irregular to provide material for really organized knowledge. Of course they had their uses, but one wondered whether the absence, at that period, of continuous information and systematic observation of temperature and precipitation, such as we have for the nineteenth and twentieth centuries, was not irremediable. The historian of seventeenth-century climate needed in fact to be able to apply a quantitative method comparable in rigor if not in accuracy and variety to the methods used by present-day meteorologists in the study of twentieth-century climate.

The elements for such an approach, and for the quantification of the history of climate, did exist: they were even available for periods long before thermometers and barometers were perfected and brought into general use. In America, for example, dendrochronologists have used tree rings to create elaborate techniques for the study of climate. For this they have laid under contribution the incredible "sequoia historian" and very old pines and firs: their growth rings yield, year by year, sometimes for over a thousand years, a complete pluviometrical record.

In Europe too the dendrochronologists have achieved excellent results. But except perhaps in Germany there are no continuous tree series comparable in duration or in abundance of original data

to those which have been established for Arizona. Fortunately, for Europe and for those parts of Asia once the sites of great civilizations, there is a substitute. For almost a century researchers into ancient climates, in France, Germany, and Japan,³ have made use of the phenological method. Phenology is the study of the dates at which certain phenomena occur in plants about which we possess records; for example, flowering and ripening in vines and cherry trees. In 1955 M. Garnier published an article on this subject in *La Météorologie* which though modest in form was cardinal in content.⁴ In it he rediscovered the forgotten virtues of Angot's work on wine harvest dates.⁵ He showed that by using very long series of these one could check, or even roughly reconstruct, temperature curves: thanks to the information hidden in the wine harvests one could establish more firmly the long chronicle of hot and cool summers, mild or chilly springs. A collection of masterly series just as rigorous as those of the dendrochronologists was available to western historians, who for a long time had unjustly despised phenological sources.

The work of Angot and Garnier was the starting point for my own initial research between 1955 and 1960. I was trying to find a series of wine harvest dates previous to 1750 or 1800. I found a considerable number in municipal records, ecclesiastical accounts, and legal and police archives of the seventeenth and eighteenth centuries. In this way I was able to supplement André Angot's great record for the south of France. The hunt ended in an important discovery when in 1959 I came upon the unexpected treasure that every historian meets two or three times in his life. In Avignon, in the Musée Calvet, I literally stumbled on the huge pile of harvest dates collected by Hyacinthe Chobaut, together with much other data, in the course of a lifetime of scholarship. This self-effacing Avignon archivist was one of the true pioneers of the scientific history of European climate: his figures are to be found before my own in the tables at the end of this book.

But wine harvest dates alone would not have been enough to resurrect the meteorology of a bygone age. Another factor presented itself, not exhaustive but equally indispensable. It did not relate directly to a strictly quantitative history of climate, but

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threw invaluable light on it in the long term, in terms of centuries or spans of centuries. This new factor was historical glaciology of the documentary period.

Nearly thirty years ago, in an article called "Glaciers,"⁶ Matthes, following Mougín and Kinzl, told the fascinating story of the Chamonix hamlets buried at the end of the sixteenth century by the advance of Alpine glaciers. Their inhabitants were the terrified and indirect observers of the subtle climatic variation of modern times. First through Matthes, then through Mougín, Richter, Kinzl, Monterin, and many others, I gradually became acquainted with the original and often neglected bibliography of articles on the modern history of Alpine glaciers, in the sixteenth, seventeenth, and eighteenth centuries.⁷

Most of these articles were piously, even coyly buried in the esoteric and dusty pages of agricultural revues, bulletins of learned societies, or the unobtainable yearbook of some Teutonic Alpine club of the 1880s. But the difficult task of hunting them out was well worth while, and led me on to important new sources. Their authors referred me to even older experts on glacial history, and I gradually learned to trace back these bibliographies to their sources just as one traces back the remotest tributaries and most complicated ramifications of a river. As I went along I disregarded parasite branches, unprofitable or redundant authors, plagiarists and those who merely repeated others, seeking always for the fresh water of documents and texts. At last I came to the sources themselves, in the old archives of Chamonix which are preserved at Annecy. I examined the ancient plans and maps; read the reports of such early visitors to the glaciers as Sebastian Münster; and, following the example of my predecessors, both historians and glaciologists, I compared all this data with the results of observation on the spot.

This last phase led me to the Chamonix valley itself and to Grindelwald, Courmayeur, Rhonegletscher, and Vernagtferner: all the places where one could compare present-day glacial fronts with those which appear before 1800 in published or unpublished engravings, maps and texts.

So forests, wine harvests and glaciers were my starting points. But my search widened out on the way to include other things besides its original objects. For a historiography of recent climate had to take into account the work of the most various and recent of specialists, from the professional meteorologists who reveal the climatology of the nineteenth and twentieth centuries to the pioneers of pollen research, invaluable to anyone interested in the climatic variations of the early Middle Ages. The following chapters refer as occasion arises to these various spheres of research.

As the search through the archives and the exploration through books gradually combined, new horizons opened before me. My subject, and that of this book, was no longer climate merely in its human or ecological aspects, but climate as a subject of historical study in itself.

It was an attempt worth making. My researches among unpublished documents, among harvest dates and archives relating to glaciers, revealed a strange landscape which was already magnificently pioneered, but which could still have further light thrown on certain aspects of it. It was a landscape that appeared almost unmovable. Yet slow fluctuations became perceptible when one observed them over several centuries. No doubt these fluctuations were slight and therefore comparatively unimportant in relation to human evolution proper. But the documentary historian, supplementing his privileged access to original sources with the results of the work of other specialists, might well make a modest attempt to establish an accurate chronology of these fluctuations. This book makes no claim to be an exhaustive history of world climate, taken as a whole over the last thousand years. It would be absurd to attempt so immense a task. What the reader will find here is essentially a methodological introduction to the problems presented by the historiography of recent climate in Europe and America, from the point of view of a documentary historian. The period covered includes those centuries when observation of climate came within the province of the historian: that is, the sixteenth, seventeenth, and eighteenth centuries. But for purposes of comparison, and in order to throw light on the past from the

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present, there will be frequent references to data accumulated by professional meteorologists in the nineteenth and twentieth centuries. And when unpublished documents or the results of parallel research warrant it, I shall also deal with certain aspects of the climatic fluctuations of the Middle Ages.

CHAPTER I

THE HISTORICAL STUDY OF CLIMATE

Climate is a function of time. It varies; it is subject to fluctuation; it has a history. While it is true that the idea of climate is a summary description of meteorological conditions over a series of years,¹ it must be added at once that such descriptions never exactly match from one period to another. Even the most extensive figures we have, those covering periods of a hundred years, do not give an exact picture of the climate of any given region.² All this is well known to meteorologists, geographers, glaciologists, geologists, and palynologists,³ who come across evidence of it every day in their researches. And yet historians themselves, although they are directly concerned, have not yet really addressed themselves to the historiography of climate as a subject of special research: such few attempts as have been made have often ended in failure. Why is this?

The explanation lies, in the first place, in the attitude adopted by the first historians of climate, who instead of studying climatic change in itself and for its own sake launched themselves into something quite different and highly dangerous, namely the climatic interpretation of human history. Elsworth Huntington, for example,⁴ did not really make an unprejudiced study of climatic fluctuation in Asia, but tried from the outset to account for the Mongol migrations in terms of climate. Similarly Le Danois, studying ocean climate, was primarily interested in movements of fishing and fishing grounds, and in fluctuations in Paris fashions as an index of reactions to changing weather conditions.

Ignazio Olagüe "explains" the history of various Mediterranean countries in terms of fluctuations in rainfall.⁵ There are plenty

of other examples of this exaggeratedly anthropocentric approach, but let one more suffice.

In 1955, in the *Scandinavian Economic History Review*, the Swedish historian Gustav Utterström published an important, interesting, and well-informed study on "Climatic Fluctuations and Population Problems in Early Modern History."⁶ This article brings together almost all the available data on the influence of climate in medieval and modern history, and represents one of the furthest points ever reached by the traditional method. It may therefore be useful to analyze it at some length before describing some other techniques.

The author sets out to prove that there were long periods of climatic deterioration which had disastrous economic effects on Europe. He deals mainly with two periods: the fourteenth and fifteenth centuries, and the seventeenth.

According to him there was a general cooling of the climate in the fourteenth and fifteenth centuries. Utterström supports this assertion with many but somewhat motley facts. The first symptom he adduces is the fact that between 1300 and 1350 fishing took the place of cereal-growing as the chief economic activity in Iceland. One might have thought this change to be as open to an economic interpretation as to a climatic one. But the climatic interpretation is backed up by an appeal to the chronology of glaciers and ice sheets (we shall come back to this chronology): the advance of the glaciers, supposed to have begun "after 1200," went on in Iceland during the fourteenth and fifteenth centuries, "continued" in the sixteenth, and reached its maximum in the seventeenth and eighteenth. This extension of the ice sheets is supposed to be both confirmed and dated by the destruction in the fourteenth century of Norman colonies in Greenland. The destruction must have come about in a very subtle fashion, since the Normans are supposed to have been victims both of the spreading of the ice cap and of the resulting mass "descent" of the Eskimos, pursuing seals and icebergs to the south.

The decline of vinegrowing in England in the fourteenth century, after it had been at its height in the thirteenth, is also put forward as the result of a climatic revolution rather than, as had been

supposed, a mere sign of economic change. The heyday of the English vineyard in the twelfth and thirteenth centuries had already led to the conclusion that the English summer must have been warmer then than it is now. True, German vineyards did not decline at the same rate as the English after 1300-1350, but apart from certain short periods their good years were only "occasional" in the fourteenth and fifteenth centuries, and this was taken as another sign of a general deterioration in climatic conditions.

According to Utterström, the end of the fifteenth century, after 1460, and the first half of the sixteenth century enjoyed a much more clement climate than the period immediately before, but about 1560 another cool and unpleasant period began, which lasted right through to the seventeenth century. By way of proof we are told that Swedish grain harvests "dwindled" between 1554 and 1640; but one would very much like to know how anyone has been able to measure variations in yield in Scandinavia in the sixteenth and seventeenth centuries. But let us pass on to the suggestion that the southwest Baltic and the Thames, which had not frozen between 1460 and 1550, had much more rigorous winters during the second half of the sixteenth century and the first half of the seventeenth. In England, cherry trees spread north at the beginning of the sixteenth century, but during the reign of Queen Elizabeth the weather is supposed to have become "cooler" again. Lastly, the glaciers began to advance again at the end of the sixteenth and during the seventeenth century. This was the "little ice age." This advance, said to be the greatest since the Ice Age, is supposed to have been most marked in the Alps and in Iceland. There were various episodes, but no real retreat of the ice until about 1890.

The author supports his thesis by quoting the economically catastrophic years that occurred in Scandinavia during the period concerned: 1596-1603; the years immediately before and after 1630; 1649-1652; 1675-1677; and the 1690s.

He also presents the flow of Baltic grain toward the Mediterranean after 1590, and the depopulation of Spain in the seventeenth century, as clear signs of a reversal of climate. Another

symptom of a "change of climate" is the fall in the number of sheep in Spain after 1560, and especially after 1600.

In short, the whole "crisis of the seventeenth century," of such great historical importance, is supposed to be of climatic origin, and unexplainable in terms of a mere internal analysis of contemporary European society and economics.

The article provides a rich harvest of facts and data of all kinds. But a lot of these facts are not a priori climatic: the decline of vinegrowing or sheep-rearing, for instance; the spread of wheat or cherry trees; and still more the changes in the cereal trade. In the present state of our knowledge all these things can be explained equally well, or better, in terms of purely economic considerations.⁷ When, on the other hand, the author quotes years of climatic hardship and agricultural deficit, he is adding real meteorological evidence. But in order to prove his point he would need to demonstrate, rigorously and with statistics, that these bad years all resulted from more or less comparable meteorological conditions; and then that they occurred with noticeable frequency during the long period in question, or at least that they were noticeably less frequent during the preceding or following periods. Until it has been shown that there is a significant difference between two periods, the bad years have to be regarded not as a long series but merely as episodes in short-term meteorological fluctuation. That being the case, the author is not justified in using them to support his argument about long-term fluctuations in climate. It is as if a historian or an economist were to try to demonstrate a lasting rise in prices by taking a few periodic peaks of a graph while taking no account of its general curve. By the same token, a few outstandingly cold winters here and there during the fifteenth century are not enough to prove that the century as a whole was a cold one.

Utterström's glaciological data are those which are the most indicative of some long-term climatic movement. But the chronology of these movements is too vague and their influence on human history too uncertain to warrant such ambitious conclusions as he draws from them. What should we think of a historian who tried, even partly, to explain economic progress in Europe since 1850 by the warming up revealed in the retreat of Alpine and other gla-

cers since that date? Utterström is doing much the same thing when he tries to establish a close connection between the advance of the glaciers and the economic crises in Europe during the fourteenth, fifteenth, and seventeenth centuries.

But anthropocentrism is not the only weakness to be found in the various attempts at historical interpretation of climate. Other researchers, some historians, some not, have gone cycle-mad. Douglass, the eminent pioneer of American dendrochronology, lost years and devoted incredible statistical refinement to searching his tree rings for an eleven-year sunspot cycle.⁸ Jevons junior and senior and Henry Moore did likewise with the maize trade, unemployment and the price of pigs in Chicago⁹; and Beveridge himself was influenced by their work. Brückner adopted a thirty-five-year cycle for temperature, wine harvest dates and glacier termini.¹⁰ As for "astroclimatic" cycles of forty thousand years, divided into "subcycles," they were still working up havoc till quite recently.¹¹ Sometimes such speculations lead to astonishing predictions about the future: one cycle-hunter, basing his calculations on the periodicity he has discovered, is bold enough to forecast what the level of the Seine will be in the year 2000.¹²

Such researches are to the real history of climate what the philosopher's stone was to oxygen. Yet they have been carried on ceaselessly by generations of researchers. But now they have received a deathblow. Without absolutely denying the possibility, in theory, of regular periodicity, climatologists no longer really believe in cycles of unvarying duration or in an "éternel retour" of climate. They are much more interested in the idea of fluctuation, which undoubtedly occurs, but over varying periods.

Serious historians did not wait for the verdict of scientific meteorology. They shrugged their shoulders at the daring reconstructions of the climatic romancers. One economic historian spoke for most of his colleagues when he said, "I don't trust climatic explanations."¹³ His mistrust was quite justified: for each "explanation" of this kind it is easy to adduce a purely human and immediate consideration which is both adequate and intelligible. Demography, lack of currency, scarcity, and low productivity account

for "crises" in certain sectors in certain periods of the seventeenth century. As for the so-called "crisis of the seventeenth century" as a whole, historians still dispute among themselves¹⁴ whether it really existed as such, and whether it really affected a whole century. It would be rather premature to seek a climatic explanation for a phenomenon whose existence is not even certain! Economic motives or the caprices of taste are often enough to explain other changes, such as those in fishing grounds and even more in fashion.

To turn toward the Mediterranean, the relative decline of Spain is not due to a fall in humidity but to the social structure, a totalitarian religion, the monetary fluctuations of the Renaissance and Baroque periods, a system of values not adapted to capitalism, and geographical conditions inadequate to modern economic needs. As for the series of disasters in the fourteenth and fifteenth centuries, the occurrence of which no one calls in question, epidemics of pulmonary or bubonic plague, together with many other factors, had more to do with them than any hypothetical wave of cold or wet.

To tell the truth, controversy has been and still is so active on this last problem of the catastrophes of the late Middle Ages (1348-1450) that it may be useful here to sketch the beginnings of an ultimate climatic study of the "great crisis" of the fourteenth and fifteenth centuries. Among its many possible causes, one that is frequently invoked, at least as a hypothesis, is the recurrence of wet years¹⁵ during the century that begins with the year 1310, to take a good round figure. These wet years, which destroyed or rotted wheat and grape harvests, are supposed to have helped plunge agriculture in the West into depression and sometimes even famine during that very long period.

Such a hypothesis calls, in the first place, for an accurate examination of the volume of the harvests during the period concerned, and for a comparison with the periods before and after.

But while such an examination, conducted for example on the great wheat-producing area of northern France, may confirm the theory of a deterioration in climate, it does not necessarily confirm

that of a deterioration in harvests sufficient to have disastrous consequences on human life. It is true that during the very wet decade beginning with 1310 the floods of 1315¹⁶ inundated harvests, vineyards, and seeds in the ground with immediate consequences that were terrible enough. The 1316 wheat harvest was very poor; food was scarce; ingenious bakers mixed what little flour they had with the droppings of pigeons and pigs. Prices rose; eggs were sold in Limoges at a penny apiece; in France, Flanders, Germany, and England the poor died in millions from hunger and epidemics. Cannibalism was recorded in Britain and Livonia. In southern France, in 1316, half-religious, half-popular processions of snails were inaugurated, presumably to ward off the rain supposed to be their familiar element.¹⁷ At Tournai, in gloomy Wallonia, the inhabitants were even reduced to drinking the local wines because the French vineyards that usually supplied them had had such a bad harvest: the grapes had been washed away by the rain.

All these dreadful or picturesque details, however, only concern the short term—the decade of 1310,¹⁸ in which the famine of 1316 particularly stands out. But in the long term, on the scale which interests the historians of the fourteenth century, it seems that agricultural production very soon got over the disasters of 1315. We may confine ourselves to a few important examples. The receipts in wheat, wine and hay of the abbey of Saint-Denis near Paris, which represents a wide sampling of estates and vineyards,¹⁹ are as steady as a gyroscope between 1284 and 1342. It would be very difficult to discern the slightest decline in the harvests there; of a long crisis during those sixty years there can be no question. It is true that brief climatic or other incidents occasionally affect the graph of the garnerings of Saint-Denis, but they have no lasting effect on the trend, which is in the long term even and horizontal over the whole period from 1284 to 1342. During this time the hypothetical "deterioration of climate," if there was one, certainly had no negative consequence for the rich, stable agriculture of the Paris area. It was the entirely nonmeteorological series of disasters brought about by the plague, the English and the brigands after 1346-1348 which make the hitherto impassive wine and wheat graphs for Saint-Denis go hurtling downward.²⁰

The same situation is found in Flanders and northern France. If the hypothesis of an unusually wet fourteenth century and a corresponding decline in harvests were correct, one would expect to find, in this area which even normally is covered all the year in heavy rain clouds, yields of wheat which if not poor were at least declining. But no such thing. In Picardy, Artois and Flanders, on the cereal-growing estates of Thierry d'Hireçon (an astonishing character who was one of Guillaume de Nogaret's bodyguards, then devoted many years to agriculture, finally becoming a monk and dying bishop of Arras), and on the Douai estates of the abbey of Notre-Dame-des-Prés, the harvests around 1319 to 1340 were good and abundant. Whether the year was good or bad, Thierry and the abbey of Notre-Dame harvested an average of eight to ten grains for every one sown: this is entirely comparable to the results obtained in the same region during the good years of the eighteenth century. It is only after 1340, when first military operations, then epidemics, ravaged the country, that the rural prosperity of Artois and Hainaut was halted for about thirty years. As for excessive rain, according to excellent documentary evidence it appears to have played no part as a factor in this later decline.²¹

It is also far from certain that the decline in winegrowing in the north,²² so clearly marked in the fourteenth century, can be ascribed to a deterioration in climate. Let us take as an example a marginal vineyard which no longer exists: the one that used to lie to the north of Paris. From 1350 to 1400 and after, it was in full decline. Was this the fault of excessively severe winters which killed the plants, or of extra frequent spring frosts, or of wet summers which prevented the fruit from ripening? Not at all. Contemporary texts give the real answer. In 1399 the abbot of Saint-Denis sent a party of monks who were experts in matters of wine to inquire into the lamentable situation of the monastery's vineyards. They found them lying uncultivated and abandoned. How on earth could this have come about?

At first sight the answer handed down to posterity in the *Livre vert* (Green Book) of Saint-Denis²³ is very optimistic. "Your vines," the investigators tell the abbot, "in principle give an excellent yield. Well looked after, they could all produce four pipes

to the acre." This means a minimum of twenty hectoliters per hectare, and probably much more, thirty hectoliters at least, if, as seems highly probable,²⁴ the monks calculated according to the Paris *arpent* or acre (34 ares) and the *queue* or pipe of Saint-Denis (386.5 liters). Such yields are magnificent for that period, and indicate clearly that the Paris vineyards, northerly though they were, were no more subject to unfavorable climatic stress in the fourteenth century than at other times.

But that being the case, why the crisis, why were the vineyards in such bad shape? The monks' considered answer to these questions again rules out climate. They told the abbot that the vines, if cultivated normally, would produce four pipes of wine to the acre. As a pipe sold for 32 sous, each acre would thus bring in 128 sous. But unfortunately profits were eaten up by expenses. The mere cultivation of the vines, without counting the always high cost of vintage, absorbed 140 sous per acre—more than the proceeds of the sale of the wine. They concluded that the best thing was to abandon winegrowing altogether as no longer profitable.

I have dwelt on this report by the monks of Saint-Denis because it seems to me to throw a very clear light on the whole matter. If the marginal northern vineyards receded in the postplague years of the fourteenth century (after 1348), it was not because the climate did not provide the vines with their fair share of warmth. It was because, as a result of the depopulation caused by epidemic and war, labor had become too dear. The counterproof to this is easy: a century and a half later, around 1560, according to figures taken from winegrowers' accounts, the yield of the Paris vineyards had not increased but, since real salaries had become much lower than in 1400, profits were considerable. So whether it rained, blew or froze, the Paris winegrowers, right at the beginning of the Little Ice Age, still went about their work with a will. With their profits they paid for their sons' studies and for their grown-up daughters to learn to play the lute and spinet and even to write.²⁵ So once again a close examination of unpublished documents rules out the climatic explanation, too generally and too ambitiously applied. A thorough study of meteorological conditions in the first half of the fourteenth century²⁶ shows, moreover, that the five decades

from 1300 to 1350, taken as a whole, were not exceptionally wet, and therefore not exceptionally unpropitious to wheat- or wine-growing, in the areas near the Channel. In the scale established by H. H. Lamb the ten-yearly index for the English summer between 1300 and 1340 fluctuates around 6.5, 6.5 again, and 6.7. In other words, it is comparable to the indices for the driest decades in the eleventh, twelfth, and thirteenth centuries. It is only during the absolutely exceptional decade from 1310 to 1319 that this index temporarily soars to 15.0. This was caused by a very temporary wave of heavy rainfall, which as we have seen was a contributory factor in the great famines of 1315-1316. It does not indicate a lasting trend of wet summers clouding all the first half of the English fourteenth century.

On the contrary, it was after 1350 that England had a series of decades (1350-1360, 1360-1370, and 1370-1380) characterized by wetter summers. But in fact in the generation from 1348 to 1380 the effects of the plague, which were not operative in the previous half century, had become so crushing that the climatic factor becomes only secondary. It has been said that the plague of 1348 carried off 25 percent of England's population; that of 1360, 22.7 percent; that of 1369, 13.1 percent; that of 1375, 12.7 percent. Even if these figures, which are those of Russell,²⁷ are contested in detail, and historians have not denied themselves that pleasure, there is no doubt of the enormous human losses caused by those four outbreaks of plague. In comparison with these terrible blows, what could be the effect of a few exceptionally heavy falls of rain, or a few spoiled harvests? It is quite clear that in the West, after 1348, the chief factor responsible for the stagnation, the depopulation, and the subsequent economic crisis was not the climate. It was definitely, among other factors, Yersin's bacillus; and in the second place, on the Continent, war, brigandage, and the huge wave of criminality and gangsterism which spread over France at the time of the Hundred Years' War, and in comparison with which the Chicago of the 1920s was a haven of peace.

But to get back to the main issue: the anthropocentric approach which consists in taking a vast human crisis like that of the late

Middle Ages and trying to give it a climatic explanation is not a helpful one. The naïve anthropocentrism of the first historians of climate sometimes even took the form of a vicious circle. Hunting-ton explained the Mongol migrations by the fluctuations in rainfall and barometric pressure in the arid zones of central Asia.²⁸ Brooks²⁹ carried on the good work by basing a graph of rainfall in central Asia on the migrations of the Mongols! The first extrapolated from the barometer to the Mongols, and the second, with even less justification, from the Mongols to the barometer.³⁰ What better example of a serpent biting its own tail!

Such "methods" have provoked in many scholars and historians a completely negative reaction and sometimes the temptation of an easy triumph. Some simply deny that there have been any "recent" variations in climate, i.e., any that have taken place in historical times. Angot and Arago in the nineteenth century, and Aymard³¹ more recently, invoke commonsense evidence such as the stability of vegetation limits and winegrowing areas in order to dismiss the possibility of any climatic fluctuation since antiquity. All they set against the headlong exaggerations of climate fiction³² is a rigid fixity. But this type of criticism overshoots its mark, and rules out even the possibility of a scientific history of climate.

But such a history is feasible, on condition that it frees itself entirely (just as climatological geography must do³³) of anthropocentric prejudice, and does not try to force reality into the straight-waistcoat of cycles. On condition also, and above all, that in establishing its basic series of data it limits itself to facts which are strictly climatic. A migration, a famine or list of famines, and still more a graph of agricultural prices are not and cannot be facts which are strictly climatic. Migration results from extremely complex human motives and compulsions. Famine derives from adverse agricultural conditions, in which the climatic element can never be deciphered a priori, whether it is a matter of hail, frost, rain, fog, pests, scorching heat, drought, or meteorological incidents, which are sometimes of very short duration and little climatic significance.

On the other hand valuable climatic documents can be derived from studying early meteorological observations and, before these,

records and texts of all kinds giving nonquantitative accounts of the meteorological nature of certain years, days, weeks, months or seasons. Other useful documentary evidence is in the dates of harvests (rather than their volume), and in references, descriptions and pictorial evidence concerning glaciers. All this, provided it has been critically examined and duly translated into quantitative terms, can serve as source material to the historian of climate—on condition, of course, that he works via the history of the various different meteorological factors in themselves: temperature, rainfall, and then, where possible, wind and barometric pressure, sunshine and cloud. It is on these conditions only that fictionalized history of climate can become scientific history of climate, just as alchemy eventually turned into chemistry.

An objection might be that this kind of research, these documents and methods, do not, as such, directly relate to human history, but only to a sort of physical history, a history of natural conditions. Does not the historian who devotes himself to such work risk betraying the vocation assigned to him by Marc Bloch in a famous passage: "Behind the tangible features of landscape, behind what are apparently the most frigid of writings . . . it is human beings that the historian is trying to discern. If he does not succeed in that he will never be anything, at the best, but a learned hack. But the true historian is like the ogre in the story: wherever he smells human flesh he recognizes his prey."⁸⁴

Nicely put. But in spite of my immense admiration for Marc Bloch his definition has always seemed to me too narrow, not adequate to the true scientific spirit. The time has gone by when Greek philosophers and physicists spoke of man as "the center of the universe" and "the measure of all things." Since the pre-Socratics and Ptolemy there have been many Copernican revolutions.

If one took Bloch's metaphor of the ogre and human flesh literally, it would mean that the professional historian would systematically neglect a whole category of serial or qualitative documentation, such as early meteorological observations, phenological and glaciological texts, comments on climatological events, and

so on. A strictly human historiography could take such documents into consideration, but never to work out completely and for itself their intrinsic climatic content, only to check some usually minute point in human history or local or specialized knowledge (for example, some detail on the history of the thermometer at a certain period, or the evolution of vintage techniques in a certain vineyard).

In fact, total lack of interest in these matters is the attitude which has prevailed so far. Almost no historians have addressed themselves to the early series of climatological documents.

This has serious consequences. Even if these documents do not essentially relate to human history, according to Bloch the only history worthy of interest, the search for them and their subsequent analysis and application is a job strictly for the historian and for him alone. If the qualified workman does not present himself, the document remains unexploited and abandoned. At the worst—and the worst often happens—it is lost. How many are left now of the dozens of eighteenth-century manuscript meteorological registers listed by Angot in his great article in 1895?⁸⁵ Naturally, the worst does not always happen. In many cases other qualified workers step into the breach left by the historians.

In England, for example, a country much smiled on by the gods in the matter of history of climate, meteorologists and geographers have lent a hand. They themselves have collected early texts on extremes of weather and built up excellent series from them.⁸⁶ The medievalist John Titow,⁸⁷ too, has discovered in the manorial archives of Winchester hundreds and hundreds of unpublished texts on the meteorology of the thirteenth century.

They have ordered this matter differently, however, in France. For a long time the absence of historians has been unbroken and unremedied. Is it by chance that historical phenology had made little progress since Angot? That since Mougín, Richter and Allix practically no early texts of any significance have been dug up concerning Alpine glaciers, and no meteorological series been built up for the eighteenth century in France since the work of Renou?⁸⁸ No, it is not by chance. Science has stood still over the fascinating question of climatic fluctuation because after the initial

work of the pioneers and inspired amateurs, the specialists who might among others have taken up and advanced the research—the medieval and modern historians—have shirked it. They were only interested in human history, and to deal with natural phenomena as such seemed to them unworthy of their humanist vocation.

Unless, therefore, one wants to let a whole province of possible research lie fallow, one must, if not contradict, then at least modify and fill out what Bloch said. It is mutilating the historian to make him into no more than a specialist in humanity. The historian is the man of time and archives, the man to whom nothing which is documentary and chronological is alien. This being so, he can and still most of the time will be Bloch's charming anthropogous ogre. But he may also in certain cases be interested in nature for its own sake, and make known by his own irreplaceable methods nature's own special Time and, in particular, the rhythm and recent fluctuations of climate.

In other words, just as there is a human geography and a physical geography, a *morphology* and a *geography*, so there can also be, for the so-called historical period which is covered by written documents, a human and a physical history—a *geohistory*, to use the word in more restricted sense than that given it by Fernand Braudel in distinguishing from *history* proper.³⁹ Both are parts of science; they are not of equal importance, but both are served by the same methods, and both concern the historian, with his traditional rules governing the rigorous use of documentation, and his new norms of quantitative elaboration.

Climatic history, thus defined as independent in its subject of research but related to human history by its methods, has to face various "frontier" problems.

First of all there are the frontiers with the other disciplines which up till now have occupied themselves, alone and on their own account, with the "recent" evolution of climate: meteorology, geography and morphology, geology, palynology, dendrochronology, archaeology, glaciology, radiocarbon dating.

The historian of climate must begin by learning all there is to

be learned from these researches older than his and already built up into bodies of theory and results. He looks to them for the general framework of his own inquiry. Also for basic information on already well-marked-out climatic fluctuations and their climatological interpretation. These "requests for information" have been made for a long time now: thus it was only the glaciologists' and geomorphologists'⁴⁰ observations of recent moraines that made possible a correct interpretation of early texts on glaciers—texts which were brought to light by local historians, scholars and archivists.⁴¹ Similarly it was as a result of comparison with the systematic observations of meteorologists that the phenological and wine harvest date series took on their full scientific meaning.⁴²

But the historian is there to give as well as to receive. The very first results of his documentary researches enable him to export invaluable information across his frontiers, and give the other disciplines interested in the evolution of climate the thing they most need: accurate chronology, exact date. Thus the moraines of Chamonix and the Tyrol show glaciologists, by their pedological recentness and through carbon dating, that there was a considerable glacier advance between 1550 and 1760, or more exactly still between 1600 and 1710.⁴³ But texts from archives not only confirm this advance but also *date* it much more precisely than any carbon dating, which is only correct to within about a century. These texts show⁴⁴ on the one hand a permanent state of glacial advance in the seventeenth century, and on the other hand, against this background, individual glacial maxima in 1600–1601, 1643–1644, and 1679–1680.

Another significant fact is that when meteorologists, geologists, and biologists wanted to find out about the climate of the eleventh and sixteenth centuries, they invited a dozen rural and economic historians to their meeting. And they entrusted to them the task of establishing most of the series for the periods concerned, the historians having brought along with them the continuous, annual, quantitative, homogeneous lists of figures which the scientists had need of.⁴⁵

So the relations between the history of climate and the related disciplines involve a fruitful mutual exchange, a constant flow of

information in both directions. Hence the dual character of the present book, which consists partly of exposition, made necessary by the present compartmentalization of specialties, of results already obtained by related disciplines, and partly of a historian's history of climate.

Another frontier and another type of relationship still remain to be described: they are those between climatic and human history. Once the first of these is in possession of its own methods and initial results (from which, as has been said, all anthropocentrism must be banished), it can lead into the second. We then arrive at a second stage in our research, in which climate is no longer looked at for its own sake but "as it is for us," as the ecology of man. Climatic history would then become ecological history, asking such questions as whether the fluctuations of climate—or to put it more modestly, the brief fluctuations of meteorology—have reacted on the human habitat; on harvests and thus on economy; on epidemics and diseases, and thus on demography.

But, I repeat, this is only a second stage in the study of the history of climate, and once which is by no means a priori necessary. In this book I make no claim, and could not even attempt, to give a thorough account of all the successive stages. So I shall deal mainly with the problems of the first strategic stage, which itself was too long neglected: the initial, necessary stage which leads (for the period before which rigorous observations were made)⁴⁶ to the construction of a pure climatic history free of any anthropocentric preoccupation or presupposition. I shall only deal briefly and "laterally," without any pretense at completeness, with the problems of the second stage, which may perhaps lead to the establishment of an ecological history, a climatic history with a human face.

CHAPTER II

FORESTS AND WINE HARVESTS

The pre-meteorological period, before strict observations were kept, was also the last heyday of traditional societies (before 1800-1850). In these societies, mainly agricultural and dominated by the frequently difficult problem of subsistence, the relation between the history of climate and the history of man had, in the short term, an urgency it has now lost. The peasants of earlier times recognized this when they charged special saints to act as little rustic gods and protect farms and harvests against storms or against too much or too little rain. At Semur-en-Auxois (Côte-d'Or, France) there is a fine sixteenth-century stained-glass window in the church which depicts both St. Médard, the intercessor for rain, and Saint Barbara, protectress against thunder and lightning (and also patroness of miners). The window presents a scene worthy of the Marquis de Sade; one wonders what the congregation must have made of it. It shows the martyr with naked bosom, her luscious body whipped, torn with red-hot pincers, spitted on hooks, and finally burnt at the stake. After all this careful preparation or "cuisine,"⁴⁷ the body of the saint is ready to immunize human beings against thunderbolts and guide the miners' picks safely into the womb of the earth.

Thus the peasants, in their "pensée sauvage," provided themselves with shields and lightning conductors against the dangers of climate. But it did not occur to them to hand down a systematic, accurate and continuous record of the behavior of those elements which some years crushed them and some years gave them cause to rejoice. But this gap is irreparable, and it is no use regretting the fact that traditional societies have left behind no regular observations of temperatures or rainfall.