WEATHER INFLUENCES

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Weather Influences

AN EMPIRICAL STUDY OF THE MENTAL AND PHYSIOLOGICAL EFFECTS OF DEFINITE METEOROLOGICAL CONDITIONS

BY

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WITH INTRODUCTION BY

CLEVELAND ABBE, LL. D.

*" — — a breath thou art,
Servile to all the skyey influences
That do this habitation where thou keep'st,
Hourly afflict: — —"*
Measure for Measure. *Act III. sc. 1. 8-11.*

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To the Memory

OF MY FATHER, WHOSE SUSCEPTIBILITY TO WEATHER INFLUENCES
FIRST IMPRESSED ME WITH THEIR POTENCY,
THIS VOLUME IS AFFECTIONATELY DEDICATED

AUTHOR'S PREFACE

If the present volume possesses no other virtue, it has that of being an essay into an hitherto untouched field of scientific research. As such it must be judged. Not as a final word, but as a suggestion for future investigation. And the field which it enters is not without interest to the popular mind, nor possibilities to the investigator. The basis of widespread popular opinion along any line is a fertile field for scientific research, and none more fertile than that of belief in weather influence.

Five of the chapters of the volume have, in substance, previously appeared in print. Chapters V., VI., and VII. in Monograph Supplement No. 10 to the Psychological Review; Chapter XI. in Popular Science Monthly and Chapter XII. in the Publications of the American Academy of Political and Social Science. The rest of the material is entirely new.

In its preparation, I have been placed under obligations to many persons in various parts of the country, and wish here to express my appreciation of their courtesy and kindness. To teachers, wardens of penitentiaries, and superintendents of asylums for the insane in almost every state of the union; to Superintendent Aaron Gove of the Denver Public Schools; Superintendent F. H. Brandenburgh, of the Denver Station of the United States Weather Bureau, and Chief Howe of the Denver

Detective Service, for material aid in making the studies of the Colorado climate. For help in the prosecution of the study in New York City, I am indebted to Superintendent Jasper, of the Borough of Manhattan Public Schools, the Principals of Public Schools Nos. 10 and 93, the Superintendents of the various Corrective Institutions for the City of New York, officials at the Central Police Station and Department of Public Health, officials in various national banks, Assistant Superintendent Charles B. Grimshaw of the Roosevelt Hospital, and to E. H. Emery, District Forecaster of the United States Weather Bureau.

To my colleague, Professor E. C. Baldwin, of the Department of English in the University of Illinois, I am also under especial obligations for invaluable assistance in the revision of manuscript.

EDWIN GRANT DEXTER.

THE UNIVERSITY OF ILLINOIS, APRIL 24, 1904.

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INTRODUCTION

The work on Weather Influences that Professor Dexter now offers to the attention of the public relates to a theme that has been discussed pro and con by many philosophers. The definitive conclusions attained by him in regard to the influence of certain specific weather conditions upon men are but the beginning of a long series of special researches that will afford a scientific foundation for the general belief in the influence of climate upon the characteristics of tribes and nations. Except in a very few cases no one has as yet succeeded in distinguishing between the immediate or direct influences of weather and climate on man and the indirect influences. Experiments that last but a few hours tell us a little about the immediate temporary influence of great and sudden changes of pressure, temperature, or moisture, but we have as yet only very hazy ideas of the ultimate influences of permanent changes. In fact, a comprehensive view of the possibilities of evolution and natural selection teaches that we must study man, as we do the animals and plants, in reference to every item of his environment. Weather and climate may affect him directly, but they also affect the water he drinks and the food that he eats; they dictate his clothing and dwelling and all his surroundings, so that climate can scarcely be considered by itself, and we are apt to enlarge the meaning of the word so as to include everything, whereas it should be restricted to the meteorological elements only if we are to treat the subject with any precision.

In 1860, 1866, and 1867, Mr. J. Disturnell, in various works on the influence of climate, says:

> "The habits and character of the people inhabiting the different sections of our country are more or less influenced by climate. Thus, the inhabitants of the New England states, with a temperate, cool climate, are found to be generally intelligent, industrious, humane, and frugal . . . . the same may be said of all the northern and northwestern states where an agicultural community predominates . . . . the middle belt, having a mean annual temperature of from 47° to 50°F., is crowded with inhabitants and full of enterprise, where the arts, commerce, institutions of learning and agricultural pursuits are alike encouraged . . . . the inhabitants of the border or central states, including Maryland, Kentucky, etc., are of a mixed character in regard to many of the habits and traits enumerated above . . . . the white population of the southern states are more united and fixed in their character. Climate and the institution of slavery combined have tended to render them haughty, domineering, and impatient of restraint. . . . . The inhabitants of the Pacific states and territories are of a varied and mixed character . . . . a fine climate, fruitful soil and mountain ranges engender noble temperaments in the breast of man."

The above quotation illustrates the general character of nearly all the literature that I have been able to find bearing on the influence of climate on the characteristics of men. It would seem that in general authors attributed to the meteorological climate, properly so-called, influences that are probably due to entirely different matters. For instance, the intelligence, industry, frugality, and humanity of the New England people, the enterprise of New York and Pennsylvania, the haughty bearing of the southern people, are all of them characteristics that marked the ancestors of these same people when they were living under the same climate in their European homes three hundred years ago, and when they migrated from Asia thousands of years earlier still. It simply happened that political and social conditions in England and Holland led to the settlement of three different American colonies by three different classes of the emigrants, and we have no evidence whatever that the slight differences between the climates of Massachusetts, New York, Virginia, Pennsylvania, and Tennessee have had any appreciable influence in either forming or fixing these traits of character.

A very remarkable work on the relation of climate to mankind is the famous "Esprit de Lois," published in 1748. This work had occupied its author, Baron de Montesquieu, for about twenty years, and his previous publications were but detached chapters or preliminary steps to this, in which he explains history as the result of the laws and customs that govern the nations, and these latter are but the hidden instincts of human nature, as influenced by geographical position, plants, and animals, and, above all, the atmosphere or climate that surrounded each tribe in its native habitat. A few selections and references to this work, which has been translated into every language, must impress the reader with the boldness of the conclusions expressed by its author. A general principle was laid down by D'Alembert in his analysis of the work of Montesquieu in the following paragraph:

"Nobody doubts but that the climate has an influence upon the habitual disposition of men's bodies and characters; on this account, laws ought to be framed to accord with the nature of the climate. Thus, in countries where the use of wine is hurtful, the law that forbids it is a very good one; in countries where the heat of the climate inclines people to laziness, the law which encourages labor is a very proper one. Therefore the Government can correct the effects of climate. . . . . As climate has so much influence on domestic and civil slavery, it has no less on political slavery. The people in the north are stronger and more courageous than those of the south. In general, then, the latter must be conquered; the former must be the conquerors."

Montesquieu enunciates a generalization to the effect that the inhabitants of cold countries have but little taste for delicate pleasures; in temperate countries they have more; in warm countries their sensibility is exquisite. He draws a contrast in this respect between the cold phlegmatic Englishman and the lively Italian. If we extend this comparison and include under one average all the people living north of the annual isotherm of 50° F. in the northern hemisphere, and those south of this same isotherm in the southern hemisphere, we shall at once perceive that we have included races that enjoy such great varieties of climate and that possess such varied temperaments that we are taking heterogeneous averages that can have but little meaning. If Montesquieu's idea was correct in this respect, then the phlegmatic temperament of the colder countries should be especially in evidence during long nights of the colder or winter season, and might be partly or entirely reversed during long days of the hot summer season as in the United States and Canada.

We must not speak of cold as measured by the dry-bulb thermometer, but rather of the relative sensation of cold experienced by two persons, one of them in a dry sunshine, the other in a cloudy, moist atmosphere; one enjoying a balmy southern breeze, the other a raw northeast wind; one well dressed and housed, the other poorly clad and nourished. We quite agree with Montesquieu that if the climate enforces indolence of body the inevitable result must be indolence of mind, and an eventual want of capacity for any sort of exertion, muscular or intellectual. There should result conservatism and degeneracy. Men are at best conservative beings; only the young enjoy revolutionary changes of any kind; maturer persons always desire peace, comfort, and a fair division of work and pleasure. The restless, ambitious men and women are in the minority even among enterprising nations. They are said to be especially numerous in the New England states, but this, we think, is principally a result of the fact that our ancestors were restless migrants, and is only partly the result of the severe climate of that region which killed off a large proportion of the early settlers and forces the remainder to live strenuous lives as the essential condition of existence. Agriculture is the principal labor of man, but where his labors are poorly rewarded he, and especially his children, inevitably seek for more favored regions. The mental and physical activities that are absolutely necessary in such climates as that of Great Britain, Canada, and the United States are not likely to develop a class of drones and are not consistent therewith.

Therefore the monastic life has never been greatly favored in these or other northern countries. If ever monasteries have seemed to temporarily prosper, yet eventually the national spirit of work has remonstrated effectively against indolent religious orders. Nothing is more characteristic of the spirit of industry that reigns throughout China and Japan than the annual ceremony of opening the ground with the spade performed by the emperors in commemoration of the beginning of the agricultural season, and as indicative of the honor of agricultural labor. The climate of eastern Asia, like that of eastern America, stimulates work and makes it honorable. The laws of certain nations forbidding the use of alcoholic liquors, enforcing cleanliness, rest, abstinence from meat, the isolation of lepers and other diseased persons, etc., *accord with* the necessities imposed upon them by their climates and were undoubtedly the result of ages of experience and trial, but other nations in similar circumstances have no such laws!

Many investigators have studied the relation of climate to special diseases, as though that were the most important phase of our subject. The relation of climate to health is, however, far more important, as also more difficult. The progress of knowledge during the past generation has shown that many of the diseases formerly called malarial and supposed to be produced by climate directly are in fact produced by germs, animal and vegetable parasites that are fostered by certain climatic conditions. The diseases are not to be attributed to the meteorological elements or climate directly, since under those same climatic conditions man thrives when he has once learned how to conquer the respective organic sources of disease. Until recent discoveries established the nature of the infection, it had been supposed that nations and individuals could, by a long process of acclimatization, become inured to such diseases and in fact immune. This process of acclimatization, by reason of which those individuals died out who were intrinsically unable to withstand the attacks of disease, having gone on for many generations, was generally supposed to have resulted in the evolution of typical races having special characteristics apparently consistent with such immunity. But in the light of our present knowledge, these racial characteristics should not be attributed to the climate properly so-called, but to a combination of other influences that has served to render the individuals immune to the respective diseases.

In 1854, Dr. Aubert-Roche, Chief of the French Medical Service in Egypt, published in Paris an essay on the acclimatization of Europeans in warm countries meaning thereby especially the southern coasts of the Mediterranean, Egypt, Abyssinia, and Arabia. The Red Sea offers the hottest and most oppressive climate of the globe, and yet it is found that Arabs, Turks and Copts enjoy this climate, and even the Italian, French, and English soldiers endure it. The Arab horses are among the finest of breeds, and are sent away to all climates. It is a question of acclimatization, some one says, but what is acclimatization? To this Dr. Aubert-Roche, in view of his long experience, replies:

"It is the bringing of the human organization into harmony with the climate and local influences, in order that man may live, feel well, and enjoy the complete exercise of all his faculties. Now it is common to say that climates, like localities, modify the human organism because in one place one style of life is necessary, and in another place another style. But to say that these differences are subject to certain laws and that there is a law of acclimatization, a law of harmony, between human organization and its surroundings is to provoke a research into this subject. If then we add that man, being acclimated, must be in full possession of all his faculties, this will provoke a farther study into the influence of climate on cerebration. The question of acclimatization, thus considered, necessitates a physiological examination to the action of all the agents that surround us. But this leads us too far, and we can at present acquire only an elementary knowledge, such as is given in works of chemistry, physics, physiology, and medicine. The fundamental question is one of temperament. My observations have confirmed the truth of the principle established by Royer-Collard in the memoir published in 1843 to the effect that there are really only two temperaments resulting from the predominance of one or the other of the two great organic systems, the blood and the nerves, which produce and maintain life: that is to say the sanguine and the nervous temperament. We can easily concede that in many countries the primitive races have been mixed with numerous other races, and that instruction, education, food, climate, and civilization have modified the organism. Thus, a general custom or style of clothing may predominate in a given tribe and alter its temperament. It is well recognized that the sanguine temperament predominates in temperate countries, but with certain modifications that vary as we advance north or south. Thus, there is a positive difference between the French of the north, the English, Dutch, and Germans, on the one hand, and the French of the south, the Spaniards and the Italians on the other. This difference is due to climate and food, for we can scarcely properly invoke the influence of primitive races, because the Roman and barbarian invasions have mixed all up together.

"The so-called lymphatic, the muscular, and the bilious or melancholic temperaments are to be considered as modifications of the nervous temperament, and all depend upon the influence on the system of the biliary secretion which is excited and modified by food, climate and civilization. The bilious temperament is said to belong to warm countries, but this is not true of the inhabitants of those countries, but rather of the strangers who visit them and have not yet become acclimated."

Modern students of the influence of the weather on human beings have devised the term temperature or "sensible temperature," originally "temperament," to indicate the sensation produced by atmospheric conditions in general. Thus we speak of pleasant, exhilarating, bracing weather; depressing, gloomy, and muggy weather. Now, these sensations may be produced either by changing the temperature, the moisture, the pressure, the sunshine, or even the food or clothing. The first effect of special weather conditions is to excite special emotions in the nervous system, and most of us are not sufficiently observant to be able to distinguish, or have not a sufficient command of language to be able to express, the sensations experienced with each change of atmospheric conditions. To obviate this trouble, empirical scale numbers, from 0 to 10, have been devised, first by J. E. Osborne in 1878, and later by Tyler (1901), by the general use of which one should be able to ascertain the relative frequency of different kinds of weather influences in all parts of the world. We may thus lay the foundation for at least a partial record and eventual explanation of the peculiar traits of each nation. Perhaps the simplest and best way of recording the influence of the weather is that proposed by the present writer in the *Monthly Weather Review* for 1899, namely, to prepare a diagram whose vertical ordinate represents temperature, and horizontal ordinate relative humidity. On this diagram enter figures representing the velocity of the wind on the Beaufort or other convenient scale. We place these figures at the proper temperature and relative humidity to indicate that the condition produced by these three factors is one of perfect comfort, or one most conducive to physical or intellectual work. After a few months or a year, we shall have located so many points on the diagram that we are able to connect them together by curves that may be called curves of perfect comfort. Several curves may be drawn for several wind velocities, and will show us that the curve for a given wind velocity passes through a different series of temperatures and humidities from that for another wind velocity. An equivalent idea has been suggested independently by Mr. Tyler, who prefers to draw curves of the greatest discomfort. Undoubtedly these latter curves should also be drawn in order to complete the study of the subject.

Every one must recognize the general fact that certain atmospheric conditions, such as the dryness of the air, stimulates, while other conditions, such as moist air, relax the human system. As with man, so also with other animals and plants. Each family, and species, each type of animal or plant has its *optimum* pressure, temperature, and moisture, and any considerable departure from this means a corresponding amount of change in the direction of the degeneracy in the individuals. But by a long process of adaptation, families and races may become accustomed to the new condition, and achieve a general change in the so-called optimum climatic conditions.

We are all familiar with this process of acclimatization, as shown in the history of the evolution of the cultivated food plants and domestic animals that have been transported step by step over the greater part of the globe. The seed that is perfectly at home in a given soil and climate suffers greatly at first when sown in a distant region, but after a few generations "it becomes acclimated," and in some cases does better in the new situation than in the former one. Just so it is with the human family. The tribes that migrate from one country to another after having triumphed over the novel vicissitudes of the new climate, may in a few generations develop a higher order of manhood than in the former locality, or on the other hand may degenerate permanently. In general it is said that those races that migrate from warmer to colder climates are improved thereby, but perhaps it is not wholly correct to maintain that this improvement is due to the direct action of the cold air on the fibres and muscles. We can easily see that for some men and animals the direct action of the cold chilling the surface of the skin, is to stimulate muscular activity, such as running and walking and working, because this stimulates the circulation of the blood and thereby a greater chemical activity within the body, thus evolving internal heat to counteract the external cold. But in some animals the greater cold produces the direct opposite effect; they curl up within warm coverings and hibernate. Man, on the other hand, having no natural protection, is not only forced to take active exercise, as just mentioned, but has been stimulated to invent clothing, dwellings, fire, and cooked food. Therefore a gradual transfer from a warm, moist, depressing climate to a cool, dry location, or, what is the same thing, a gradual secular change of the climate in any locality in this same direction has had the effect of increasing both the bodily and the mental vigor of the race. But of course the process may go too far. If the climate becomes so severe that appropriate animal and vegetable foods or even liquid fresh water itself and fuel can not be found, or if sunshine is too greatly diminished, the individuals that are least able to resist adverse conditions die away to such an extent that the tribe is reduced in numbers, and those who hold out are reduced in strength and intellect, stunted or dwarfed, as it were, in the struggle for existence against such severe obstacles.

When speaking of climatic influences we must not forget that clothing, food, national customs, or other features of our environment, may very largely counteract the climatic influence proper.

The migrations of the various races of men, the processes of acclimatization, the evolution of races and racial characteristics have been going on for a much longer period than is ordinarily supposed. The development of the present characteristic races of the globe has required not the 5000 years of Ussher's chronology, nor yet the 50,000 years by which we may estimate the antiquity of many archaeological remains, but rather 500,000, or some such great period as that which has elapsed since the beginning of what geologists know as the Quaternary epoch, when Pleistocene man evolved from his Pliocene ancestors. Of course, therefore, it is not a matter of direct observation and record, but rather of speculative philosophy, of faith in the continued steady working through untold ages, of the laws that we know are in operation at the present time.

Prof. A. H. Keane, at page 98 of Mills International Geography, New York, 1901, has stated the rational and logical conclusion thus tersely as follows:

"From this view of the first dispersion, it follows that these Pleistocene migrations everywhere preceded the later physical and mental development of mankind, so that the evolution of the existing human varieties and of their several cultures is presented in quite a new light. We need no longer suppose, always a somewhat violent assumption, that some fully specialized group, say, originally black, migrating from continent to continent, became white in one region, yellow in another, brown in a third, and so on. Had such a specialized group passed from its proper zone to another, it would probably have died out long before it had time to become acclimatized. . . . . The Pleistocene groups, all alike at first, everywhere presented the same generalized prototype, from which the now living varieties were severally and independently developed. The main divisions of mankind must therefore be regarded, as Linnaeus regarded them, as so many zoological varieties, all springing from common or closely allied generalized ancestors, and each gradually specialized by slow adaptation to its special environment. Like all other divisions of the terrestrial fauna, these divisions are thus the outcome of their respective surroundings. They are what climate, soil, diet, heredity, and time have made them, and that is the reason why, in the case of all later migrations, the first question that arises is one of acclimatization. If the new zone is favorable, that is, differs but little from the old, the variety persists; if not, it either merges and becomes absorbed in the indigenous element, or else simply dies out."

Everything seems to combine to prove that the existing order of events both material and intellectual has been brought about by a slow process of change, due to the interaction of the atoms and masses that constitute the material world around us. Sunshine and frost year by year slowly disintegrate or weather away the surface of the rocks, reducing them first to the talus at the foot of the cliff and then to the soil that spreads over the plain. Gradually the soil is carried to the bottom of the sea, but eventually raised far above sea level, so that we observe it as stratified rocks upon which the sunshine and the frost are again acting. By an unknown number of repetitions of this process, our continents and oceans, as we know them, have been formed and reformed, while man, with his attendant plants and animals, has been living upon them, rising and falling with them. Diffused over the whole globe even in those prehistoric days, he yet accommodated his life to every condition, and became the one lord of the whole earth. When the floors of the Atlantic and Pacific were above ocean level they may have been inhabited by man, while the eastern and western continents were below sea level. When the latter rose, man migrated to them while his former home sank beneath the ocean. These geological and orographic changes, combined with the corresponding changes in animal and plant life, the changes in climate and the frequent migrations of human tribes, afford an infinite variety of circumstances, to influence the development of a great variety of races and tribes, and are quite sufficient to explain all the variations that have been recorded.

In general the history of a race, from its birthplace and small beginning to its migration into a new country, the conquering of the tribes that it finds there, the establishment of a new empire, the culmination of its power, and its final decay and disappearance, occupies the space of two, three, four, or five thousand years; at least this is a fair average for the races of whose history we know something in Egypt, Assyria, Persia, Palestine, China, India, Tartary, and Germany. If the same average holds good for the tribes of Africa, Oceanica, North and South America, and for prehistoric races, then we must imagine the whole globe repeopled many times by different families of men, each tribe working out its own ideals in its own way under the restrictions by which it is surrounded, and giving rise to the many variations of what we all recognize as one type, the *genus homo*. Among the permanent types thus produced, we find the extreme differences that are familiar to every one, such, for instance, as the olive complexion of the Spaniard, the fair complexion of the Caucassian, the copper hue of the Malay and the American Indian, the swarthy black of some African tribes and the pale brown of others. Shall we attribute these differences to the climate in which they are at present living, or the climates of the regions from which they migrated one, two, or three thousand years ago, or to still more ancient climatic influences? Or, are these peculiarities due to food and drink, or to intermarriage and inheritance? The last is the ordinary method of the modern experimentalist in evolving breeds of cattle distinguished by their color, their flesh, or their milk; thoroughbred horses distinguished by their speed, their size, intelligence, or strength; varieties of birds distinguished by their speed, their plumage, or their song; species of plants or grains or fruits with almost any desired properties. In almost every case, one seeks to combine two appropriate cell structures or protoplasms, but never expects to directly alter the nature of the cells. Nature accomplishes the same result by selection and survival of the fittest. By cultivating a special crop in a new climate the plants do seem to become inured to that climate and to change their nature, but this is by virtue of a recognized law in plant life, viz., that erratic cells, or so-called "sports" are continually being produced. Perhaps we ought to say that Nature, in her efforts to reproduce a cell like that of the original seed, actually produces millions of attempts that resemble the original seed to a greater or less degree, quite in accordance with the law of probability of errors. That is to say, out of a hundred seeds from the same plant, there is an even chance that 75 will be like the original seed. There is also an even chance that five will differ in some notable respect from the original seed. If any one of these latter five chance to fall in the proper spot and grow, that plant becomes the so-called "sport" of the botanist, and by proper cultivation may be made to give rise to a permanent new variety. In this way plants adapted to every variety of climate have been produced, and the process goes on naturally in the open field, as well as artificially in the greenhouse. The winds, the rivers, the ocean currents, birds and animals scatter the seeds; they are carried to regions where the normal seeds will not thrive, but where the sports may. When the latter brings forth its first and second and third crops, including many of its own "sports," the wind has begun to carry these latter into distant regions, where they alone can thrive. By an almost perfectly analogous and natural method migratory tribes have carried from one country to another the seeds of cultivated crops that grew in the former home, and have found that in the new home only a very few of these will thrive; but after a few generations the sports among these have brought forth enough seed to produce crops sufficient to support the tribe. In this way, for instance, the grains that now ripen in a few weeks during the wet spring and short summer in southern Russia have been evolved from grains that required long seasons in western Europe. In this way the grains that ripen in warm temperatures and sunny skies in southern Europe have been carried to the extreme north step by step, where they ripen in a few weeks at low temperatures. In this way the grains brought from the Atlantic coast of Europe and America and carried to the plains of Kansas, Nebraska and Dakota were found to be wholly unfitted, and by failure threatened famine and the abandonment of the land as unfertile, until another race of agriculturists, profiting by the lesson, discovered that one must educate the seed to the climate, or must sow in a given climate the seed that has been successful in that same climate elsewhere. So far as concerns the growth of cereals and nearly all food plants, the proper climate consists in a proper proportion of rainfall and sunshine or temperature at the respective stages of growth, or, according to Linseer's law, every seed, in its attempt to reproduce a new crop of seed, utilizes and must have a certain percentage of the annual sunshine, the moisture, and the heat proper to the climate in which it grew, and this proportion remains the same, no matter what the latitude of the place or what the seasonal distribution of rain and cloud.

In this way, step by step, the sports of the annuals become perennials, and those of perennials, annuals; the sports of endogerms become exogerms, and those of exogerms, endogerms; humble flowers become shrubs and shrubs trees, and the whole plant world may easily be but an evolution from some single cell.

By precisely analogous means, the races of mankind must have developed. It is impossible at the present time to say with certainty what leads to the formation of the sport cells. It is not at all likely that climate has much to do with that. The structure of the male and female cells, with all their inherent variations is a matter of chemistry and physiology, in which, of course, pressure, temperature, and moisture, and the gaseous components of the atmosphere must have some influence, but it does not seem likely that the climate is the predominant influence. On the other hand when the sport cell or ripe seed is once formed, then the question of the survival and growth of the cell and the development of its progeny is so entirely a matter of climate and food that we must speak not so much of the influence of climate on mankind as of the adaptability of seed to climate.

Dry and sunny but variable weather certainly stimulates bodily and mental activity, increasing what is generally called the nervousness of many individuals, while a moist and sunny, hot, monotonous climate induces lassitude, indolence, and mental inactivity that can be counteracted only by stimulating food. In the latter case, it is difficult to accomplish the same amount of work as in the former case, and in fact less work is usually done. Such climatic conditions have contributed to the perpetuity of slavery, but the origin of this social condition is traceable more directly to the wars and rivalries of domineering men, regardless of climatic conditions. In the same tribe or family, in the same household, and under identical conditions as to climate, food, clothing, and customs we find every variety of character and taste. The strong grow at the expense of the weak. "To him that hath shall be given." In every country the successful grazier or farmer, merchant, or politician or soldier may domineer over the less successful. In Arabia and Africa, the stronger tribes enslave the weaker and sell them to the slave trader. The feebler race suffers from the system of slavery; the stronger race prospers materially and physically but suffers from an intellectual and moral point of view. We find an analogous problem in the service of our domestic animals; man has long since enslaved the dog, horse, cow, camel, elephant, and by the care that he has taken of these animals he has generally improved their condition even though they have become dependent creatures. He has probably improved his own condition by reason of the attention that he has given to the problem of exacting a better service from them. This argument merely exemplifies the mistakes of those who attribute to climate directly that deterioration of the human race that is supposed to be due to hot climates. The fact is that we find in all tropical countries as great a variety of men and talent as in the temperate countries. Each has its dominant race and subjugate tribe. The ruined cities found in central Africa, Central America, and India, and even the monuments in Polynesia, demonstrate that at one time or other in history those countries have known dominant races, on the road to the development of a higher civilization. The fact that many races have gone under, both in Asia and Europe, both in the tropic and in the temperate zones, is to be attributed to the fact that the inefficient are thinned out by rivalries, wars, and natural selection. If the severity of a climate hastens this process, it may thereby hasten the development of a race. The long lived animals and plants develop slowly before they reach maturity.

We have good foundation for the belief that a race may develop as well in one portion of the globe as another so far as climate is concerned, after it has once become acclimated. The period over which our most accurate history and observation extends is too short to justify us in anything more than the recognition of the fact that at the present time the dominant races are scattered around the north temperate zone, some of them in cold, dry, others in warm, moist climates, some in equable, and others in variable climates, and that they hold power over other tribes both in temperate and tropic zones by the power of their guns and powder rather than by any physical superiority; their intellectual development has been essentially the result of breeding and the building up of families by great attention to genealogies. Their motto has been, "Blood will tell."

We must not attribute to climate that which is more likely to be due to inheritance, but having allowed for the latter influence, we may then search among the outstanding discrepancies for that which is properly due to weather and climate, and this, as we understand it, is what Mr. Dexter has done in the book now before us.

CLEVELAND ABBE.

WASHINGTON, D. C.,
June, 1904.

CHAPTER I

SOURCES AND NATURE OF WEATHER LORE

The modern science of meteorology, emerging from the mist and darkness of ignorant guess and surmise, has left its path strewn with many a shattered idol. Jupiter Tonans the Thunderer, Pluvius the Rainmaker, and a hundred other weather gods were toppled from their lofty pedestals ages ago, while St. Swithin and his two score of saintly colleagues, whose days dominated the weather for the rest of the year, have been quite as surely, if more recently, dethroned by the delicate instruments and skillful calculations of the modern weather man.

It is interesting to turn the gaze backward and view in the light of modern scientific research the fallacies that have been corrected and the superstitions that have been lived down. In the centuries that are gone, each event was a portent; Nature's moods were not interpreted adequately in terms of cause and effect. As a consequence, the weather prophets were likely to forecast that which was most wished for, and to lay down as a general, if not infallible law, that which was a mere coincidence of totally independent events.

The enormous extent to which such foretelling has been carried on, is shown by the vast array of weather proverbs and adages handed down from the past. The origin of these proverbs may doubtless be traced in general to the universal tendency of mankind to philosophize, and in particular to the instinct of primitive races to join together striking phenomena as if in a causal sequence. Often these phenomena had no inherent connection, but early man and to an extent later peoples, only with difficulty and after much experience have been able to distinguish between the merely temporal and the efficiently causal. As to the latter term of this sequence its striking character is self-evident, though we of to-day can hardly realize the full significance of weather conditions under ruder modes of life, when man was the buffet of wind and storm.

It is not strange, then, that the attention of the earlier races, and even those of later periods before meteorological observation had become scientific, should have been drawn to the "skyey influences;" to-day the violences of nature are often extremely disastrous, even with our many means of protection from their severities and our scientific methods for predicting their approach, but in the earlier times their effects were far more appalling. Even our Galveston horror pales before the magnitude of some of the recorded results of great storms of earlier times.

No race of people has, probably, been more subservient to weather influences than our Anglo-Saxon ancestors. In their early home on the Continent, by the shores of the tempestuous North Sea, they waged a continual, at times a life and death struggle, with the forces of nature. Floods inundated their low-lying country, storms swept away their handiwork, winter brought hardships and sometimes death. The earliest literature of the Anglo-Saxons clearly shows how important to them were these weather conditions. The Old-English poem, *Beowulf*, originating in the early home of our English ancestors, is in its germ the story of the sun god, who overcomes the rigors of winter, and subdues an unfriendly nature, only in turn to be destroyed by those forces over which he was temporarily victorious. The vein of pessimism which runs through this earlier literature may, possibly, be due in part to the feeling that man was at the complete mercy of a power which, though sometimes friendly, was capricious, and often destructive. In their new home, too, the English found nature, though hardly so deadly as on the Continent, still often sombre and disastrous to crops and possessions. Small wonder, then, that our literature abounds from the earliest time in sayings and predictions in regard to the weather. Its practical significance continually forced the phenomena of sky and sea on the minds of the people.

It is not difficult to see then why this second term of the relation, atmospheric conditions, should have constantly been in the attention of mankind; but what factors determined the selection of the first term, those phenomena as cause to which the weather was related as a result? As has already been said, the phenomena of the first class must have been also of a striking nature, so that they too would gain the attention, in order to be joined in a real or supposed causal series. The query then naturally follows as to what were some of the most striking phenomena, which would arouse the interest of primitive man. We find among all nations that the heavenly bodies, particularly the sun and moon, were regarded with wonder, often with superstitious awe and reverence. It is clear, therefore, why these phenomena should become connected in the minds of the people with violent storms, destructive droughts, and disastrous floods. Inasmuch as there doubtless is a relation between certain of these phenomena and weather conditions, many proverbs of this character have a basis of truth in them and contain to this day elements of meteorology. Another extensive set of weather proverbs which might be designated as "special day" predictions are of much less scientific value, since the first term of the causal series, though striking, seems to have no fundamental relation whatever to the sequent weather change. For the most part they are based upon some supposed influence of a particular day, such as Christmas, New Year's or some special feast day of the church calendar, upon the weather for long periods to follow. Still a third set of phenomena which gained the attention of early man is connected with the habits and nature of both wild and domesticated animals; and since, as will be shown in a later chapter, an unconscious teleology has established a subtle connection between brute life and weather conditions, it happens that often weather proverbs of this nature, too, have elements of a scientific validity. There can be no doubt, also, that in this earliest expression of weather wisdom there was a seeking after truth which was based on a practical scientific spirit. For these various reasons it happens that these earliest proverbs have best endured the test of time. Their observations were inaccurate in many cases, and deductions were made from woefully insufficient data; but, nevertheless, they were conscientiously made. All three of these general classes of weather proverbs accumulated throughout the centuries. Some of them can be traced back to a single origin of greater or less authenticity, while others seem to have passed current in many and isolated parts of the earth, even before there can well have been any direct communication between those parts, or any evident circulating medium for facts or opinion. When the latter is the case, there is usually some scientific basis for the dictum, the more exact methods of meteorology having proved the approximate accuracy of the truths usually expressed in the crudest of doggerel.

As time went on, conditions of life were improved, and the stern demand of a practical necessity, always a sure corrective of scientific inaccuracy, was to a degree removed, giving a scope for fancy and caprice. Here belongs an influence which in later days has been a determining condition in the formulation of much of our weather lore; the tendency to compose a rhyme or jingle, often in a humorous vein. There is reason to believe that many of the most catchy of the weather proverbs owe their origin to this latter tendency, which reached its height in England a couple of centuries or so ago—about the time the crop of weather proverbs seems to have been most abundant. Rhyme was sought at any expense to the truth, and so potent was the craze for it that it invaded even the most serious affairs of life, as is shown by the inscription upon many a crumbling tomb-stone in the country church-yard. One especially to the point, and bearing a seventeenth century date, is as follows:

> "Here lieth the Body of Thomas Woodhen
> The Kindest of Husbands, and best of men."

Directly beneath is the explanation: "His name was Woodcock, but that would not come in rhyme." Even so, we cannot tell what many of our weather couplets might be, if some other words had "come in rhyme" better; and are forced to believe that quite the opposite, in so unimportant a matter as the predicted condition, would not have troubled the conscience of the framers of many of this class of wise sayings so severely as a missing foot, or an unrhymed line.

This tendency to make rhyme at the expense of truth has perhaps more than anything else brought the whole mass of weather lore, though unjustly, we believe, into disrepute. Even among our good English friends across the sea, who have the reputation of failing frequently to see the funny side of things, there have been current snatches of verse which surely indicate a feeling of irony regarding the weather prognostics of the time. A sixteenth century writer has expressed the sentiment in these quaint lines:

"For the year of Chryste's Incarnacyon
A thousand fyve hundred fortye and foure,
This to prognosticate I may be bolde,
That when the newe yeare is come, gone is the old."

Ben Jonson, too, in *Every Man Out of His Humour,* made one of his characters read out of a penny almanac and say:

"Oh, here, St. Swithin, the 15th day, variable weather, for the most part rain! Good! 'For the most part rain?' Why, it should rain for forty days after, more or less. It was a rule held afore I was able to hold a plough, and yet here are two days no rain; ha! It makes me muse."

Nor is subtle irony wanting in the following, which was written by one familiar not only with popular prognostications and their contradiction, but also with the general character of the British climate:

"The South wind always brings wet weather,
The North wind wet and cold together;
The West wind always brings us rain,
The East wind blows it back again;
If the sun in red should set,
The next day surely will be wet;
If the sun should set in gray
The next will be a rainy day."

For a mild sarcasm, the following rhyme of Bedfordshire, where all the names mentioned are of well known people, is admirable:

"Well, Duncomb, how will be the weather?
Sir, it looks cloudy altogether,
And coming across our Houghton Green,
I stopped and talked with old Frank Breane.
While we stood there, sir, old Jan Swain
Went by and said he knowed 'twould rain;
The next that came was Master Hunt,
And he declared he knew it wouldn't.
And then I met with Farmer Blow
He plainly said he didn't know,
So sirs when doctors disagree
Who's to decide it, you or me?"

Mr. Sharon Turner, in his *History of the Anglo-Saxons,* seems especially skeptical regarding the whole question of weather lore. He says:

"Their prognostics from the sun and moon, from thunder and from dreams were so numerous as to display and perpetuate a most lamentable debility of mind"—"one day was useful for all things: another, though good to tame animals, was baleful to sow seeds. One day was favorable to the commencement of business; another to let blood; and others wore a forbidding aspect to these and other things."

In spite, however, of such iconoclastic sentiments, it seems probable that within the whole mass of weather wisdom, we have, beside the literary flights of the rhymster, plenty of evidence of the true basis of our modern meteorological science. To attempt to separate the true from the false is not my plan; and, indeed, in all probability, it could not be done. Sir John Herschel (Note the Weather and Weather Reports, *Good Words,* Vol. 5, p. 87), recognizing the dilemma, has, however, made the following suggestion, expressed with his usual scientific caution, which, if followed by all, might make the problem a simple one:

"We would strongly recommend any of our readers whose occupations lead them to attend the 'signs of the weather,' and who from hearing a particular weather adage oft repeated, and from noticing, themselves, marked examples of its verification have begun to put faith in it, to commence keeping a notebook and to set down without bias all the instances which occur to them of the recognized antecedent, and the occurrence or non-occurrence of the expected consequent, not omitting to set down the cases in which it is left undecided—remembering always that the absence of a majority, one way or the other, would, of itself, be an improbability, and that therefore to have any weight, the majority should be a very decided one, and that, not only in itself, but with reference to the neutral instances. We are all involuntarily much more strongly impressed by the fulfillment than by the failure of a prediction, and it is only through thus placing ourselves face to face with fact that we can fully divest ourselves of this bias."

CHAPTER II

THE WEATHER LORE OF THE "SKYEY INFLUENCES."

The first class of weather proverbs, those in which striking phenomena of the heavens have been singled out as causes for storm and flood, and which in some instances, as has been said, have a basis of truth, are among the most ancient examples of our weather lore. These sayings have to do with such commonly accepted beliefs as those relating to the changes of the moon, clouds, etc. Among them the equinoctial storms come in for a good share of attention, while halos, sun dogs, moon rings and such other unusual occurrences as were anciently regarded as portents, are fully exploited. Of such consist the earliest collection of weather signs ascribed to Theophrastus, in the fourth century, B. C. He says, after speaking of signs derived from domestic and other animals: "But for the most part signs derived from the sun and moon are the most important." "The ends and beginnings of lunar months are apt to be stormy, because light fails from the fourth day before till the fourth day after a new moon. The obscuration of the moon occurs in a similar way to the eclipse of the sun." He states also that the call of the tree toad is a precursor of rain; and adds: "The ass shaking its ears is a sign of storm," both of which sayings have come down to us in a much modernized form as is shown in the next chapter.

Of all these "skyey influences" the moon was universally accredited with being the most powerful. Lunar prognostications may be roughly classed under two heads: the first those having to do with halos, coronas, lunar rainbows, and the so-called watery moon. All these do, undoubtedly, indicate the presence of moisture, either in the lower or higher regions of the atmosphere, and are probably the most trustworthy of all the supposed lunar influences. The second class of lunar influences are those based in a purely arbitrary way upon the hour of day or night at which the changes of the moon take place. These show no scientific insight and are due simply to the joining together of striking phenomena which have no fundamental connection. Of lunar influences in general, Sir John Herschel wrote as follows (*Good Words,* 5:58):

"The moon is often appealed to as a great indicator of the weather, and especially to changes as taken in conjunction with some prevailing state of the wind and sky. As an attracting body, causing an 'aerial tide' it has, of course, an effect, but is utterly insignificant as a meteorological cause. The only effect distinctly connected with its position with regard to the sun which can be reckoned with, with any certainty, is its tendency to clear the sky of clouds, and to produce not only a serene, but a calm night. This, however, is more than a simple connotation; the effect in question, so far as the clearance of the sky is concerned, is traceable to a distinct physical cause, the warmth radiating from its highly heated surface; though why the effect should not remain several nights after the full is problematical." More recently Mr. H. A. Hazen, late of the U. S. Weather Bureau, has said ("Jour. Am. Folk Lore," 13:195):

"It must be admitted that the universality of belief that the moon in some way affects our weather to a marked degree is hard to account for. Has this belief been handed down from a common origin in the dim past or have the different nations arrived at the same conclusions independently? It is quite difficult to learn just what the common idea is. In New England there is a general belief that storms accompany the new moon and, indeed, for such a belief scientific observations along the eastern coast show some basis. This, however, entirely fails in the interior, and on the Pacific coast the full moon seems to be the time of greatest precipitation. That the belief in lunar influences has touched the world of science as well as that of astrology, is shown by the fact that the following lunar table is ascribed to Herschel the elder:

"Constructed upon a philosophical consideration of the great attraction of the sun and moon in their several positions and respecting the earth, and confirmed by the experience of many years actual observation."

LUNAR TABLE

If it be new or full moon, or
the moon enter into the first or last quarter at:

	In Summer.	*In Winter.*
Noon	Very rainy	Snow and rain.
From 2 to 4 P.M.	Changeable	Fair and mild.
4 to 6	Fair	Fair.
6 to 8	Fair, Wind NW.	Fair and frosty, N. or NE.
	Rain " SW.	Rain, S. or SW.

	In Summer	*In Winter*
8 to 10	Fair if NW.	Fair and frosty if N. or NE.
	Rain if SW.	Rain if S. or SW.
10 to midnight	Fair	Fair and frosty.
0 to 2	Fair	Hard frost unless S. or SW.
2 to 4	Cold with showers	Snow and stormy.
4 to 6	Rain	" " "
6 to 8	Wind and rain	Stormy.
9 to 10	Changeable	Cold rain W., snow E.
10 to noon	Frequent showers	Cold with high winds.

This table, it might be added, is indignantly repudiated by Herschel the younger, who denies that his father could have been guilty of such a monstrous folly—which is probably true.

To weather wisdom of the first class, mentioned above, Vergil was one of the earliest contributors through the lines:

"When Luna first her scattered fear recalls,
If with blunt horns she holds the dusky air,
Seamen and swain predict abundant shower."

Here, of course, the "blunt horns" are but the visible evidences of much moisture in the upper strata of the atmosphere. *Sir Patrick Spens,* in the fourteenth century ballad of that name, has also made visible signs of moisture, as evinced by the moon, the subject of poetical comment:

"Late, late yestereen I saw the new moon,
With the old one in his arm,
And I fear, I fear, my master dear,
That we shall come to harm."

And our own Longfellow has given poetical expression to the same idea in the lines:

"I pray thee, put into yonder port,
For I fear the hurricane.
Last night the moon had a golden ring
And to-night no moon we see."

Predictions of this general character are more apt to contain truth than are others concerning the moon, since they reflect meteorological conditions which are generally prevalent before a storm.

By far the greater number of lunar predictions, however, are of a quite different character and seem to have little actual physical basis for validity, although they are perhaps the most popularly accepted of all. In great part they have to do with changes of the moon and the supposed influence of such changes upon the weather. The table already given, as ascribed to Herschel, illustrates fully the character of such predictions. Many of them have been done into rhyme, as illustrated by the following, relating to the new moon:

"When first the moon appears, if then she shrouds
Her silver crescent, tipped with sable clouds,
Conclude she bodes a tempest on the main,
And brews for fields, tempestuous floods of rain.
Or if her face with fiery flushings flow
Expect the rattling wind aloft to blow.
But four nights old, (for that is the best sign,)
With sharpened horns, if glorious then she shine,
Next day, not only that, but all the moon
Till her revolving race be wholly run,
Are void of tempests both by land and sea."

And again:

"In the old of the moon
A cloudy morning means a fair afternoon."

One can hardly get into any neighborhood, however remote, without hearing the prediction of some wiseacre that there will be no change of weather till the change of the moon. More or less scientific attempts have been made from time to time to verify or disprove this belief, the results usually lacking any semblance of its verification. Dr. Horsely examined the weather tables of 1774, as published by the Royal Society, and found that of forty-six changes of weather that year, only ten occurred upon days of "lunar influence," but two of these being at new moon, and none at all at the full. M. Flaugergues found also as the result of twenty years' observation that the barometer readings taken when the moon was farthest from the earth averaged 755mm., and when nearest 754mm., showing a difference of but one millimeter; and this in a direction opposite to that which would probably exist, if the relation between the earth and the moon were to form a valid basis for the mass of weather lore bearing on the point. On the whole we are inclined to believe, in spite of popular sentiment to the contrary, that

> "The moon and the weather
> May change together.
> But a change of the moon
> Does not change the weather."

From Aristotle's time, the value of cloud signs in storm and rain prognostications has been recognized, but the full interpretation of their meaning has been possible only since fully organized meteorological service has been established. Weather proverbs bearing upon this special phase of prediction are very numerous, no less than eighty-two examples being given by Dunwoody, many of them absolutely contradictory, and ascribing almost every effect to each peculiarity of cloud formation.

The greatest unanimity of opinion seems to center about the so-called mackerel sky, as is shown by the following:

> "Mackerel sky, mackerel sky,
> Never long wet, never long dry,"

and,

> "Mackerel scales and mares' tails
> Make lofty ships carry low sails."

The rhyme,

> "If clouds be bright
> 'Twill clear to-night.
> If clouds be dark
> 'Twill rain do you hark?"

is a very plausible suggestion based upon other cloud effects. The poet has not been the only transmitter of weather lore of this character, and we find some of the sayings much more specific, and couched in language not unscientific, as is shown by the following:

> "Soft looking, delicate clouds foretell fine weather with weak, moderate or light breezes. Hard edged, oily appearing clouds, wind. A dark, gloomy blue sky indicates wind; a bright blue sky, clear, fine weather. Generally the softer the clouds, the less wind. Small clouds foretell rain."

That in statements of this nature we have the approach to a true meteorological science we cannot doubt. In them there is no evidence of the supernatural and, when couched in common sense prose, nothing of the spectacular, but the fullest evidence of careful, scientific observation and generalization.

So much cannot, however, be said concerning the weather lore of comets and stars. An old French proverb runs:

"Comets are said to improve the grape crop, and wines produced in years when comets appear is called comet wine."

The Apache Indians, interested in quite other matters, say:

"After an unusual fall of meteors, dry weather is expected. All comets evidence the approach of some calamity, such as drought, famine, war, floods, etc."

Mists, fogs and frosts have come in for their full share of attention from the weather prophet.

"So many mists in March we see,
So many frosts in May shall be.
So many fogs in August we see,
So many snows that year will be."

does not impress us with the utmost confidence, while

"When the mist is on the hill
Then good weather it shall spill,"

carries with it a smack, at least, of probability.

The wind has received so much attention on the part of the weather wiseacres that no study of prognostications would be complete without allusion to its portentous and highly contradictory effects. That they should be contradictory is not at all surprising, when we remember that wind influences are essentially local and that weather proverbs are frequently taken from their proper geographical setting—for which they might be approximately true—and given credence in other surroundings.

"When the wind is in the north
The skillful fisher goes not forth;
When the wind is in the east

'Tis neither good for man nor beast;
When the wind is in the south
It blows the fly in the fishes' mouth;
When the wind is in the west
Then it is the very best."

This is accredited to Isaac Walton, and certainly seems to express the interests of that doughty old fisherman. Whether we should wish to accept it at all as a working hypothesis is a question, though a Bostonian could probably subscribe to at least two lines of it.

"When the wind is in the northwest
The weather is at its best;
But if the wind comes out of the east
'Twill rain twenty-four hours at least,"

and,

"Northwest wind brings a short storm;
A northeast wind brings a long storm,"

were probably not written by the same author. The tendency which we noted earlier in this chapter of ascribing special power to some special day, is not lacking in wind lore.

"Where the wind is on Candlemas Day
There it will stick till the end of May;"

and again,

"If New Year's Eve, wind blow from the south,
It betokeneth warmth and drouth;
If west, much milk and fish in sea;
If north, much cold and storm there'll be;
If east, the trees will bear much fruit;
If north, flee it man and beast,"

are illustrations of this.

The equinoctial storms are a fertile field for the weather prophet, and many of his proverbs relating especially to the months of March and September are redolent of gales. In spite of all this, however, and the popular beliefs regarding equinoctial hurricanes, hardly anything in weather lore seems less in accordance with the facts, and it looks as if our faith in them must suffer a shock, for the records seem all against us. *Nature,* Vol. 30, page 288, gives us the following interesting facts:

"For all the years 1870-1884, inclusive, a careful record of the severe storms occurring in the vicinity of the British Isles was kept and tabulated, with the idea of ascertaining their periodicity.

"Although there was shown to be something of a rhythm in their annual occurrence, the results showed no greater frequency at the equinoxes than any other time; in fact, that other periods, especially during the winter months, were much more liable to be accompanied by marked weather disturbances than just this time, the reputation of which is so bad for unseemly behavior."

Another class of weather proverbs, which from our point of view hardly deserve mention at all in a study of weather influences, are those which find some supposed relationship between a particular day or season, and the weather which follows it. From what has already been said, it is clear how a part, at least, of the proverbs of this sort have come into existence. These days are the striking ones of the calendar and call attention to themselves. A severe storm or a destructive drought follows; and the two phenomena are naturally though unjustifiably associated. Since there is no real basis for such association, proverbs of this class are scientifically worthless. The most improbable, even of this improbable class, are those which impute to some special day, or days, simply because of its number in the month or week, or its numerical or other relation to something else in the calendar, a dominating influence over the weather for long periods to come. As an illustration, "The twelve days commencing December 25 and ending January 5, are said to be the keys of the weather for the year," and "The first three days of January rule the coming three months" (the contradiction between these two seems to have troubled no one). Sayings of this general character are almost innumerable. And it is evident at a mere glance that they are due solely to the general tendency to symbolize, so prevalent a few centuries ago, and to some Pythagorean belief in the mystical power of numbers. An observational basis there certainly was not.

Another class of sayings, differing but slightly from the last, in some cases at least having a slight excuse for being, are those which ascribe to some special feast day powers little short of miraculous. Of all the saints in the calendar, St. Swithin seemed to be the most berhymed; and, if we are to judge by the number who even to this day look to him as the supreme rainmaker of the year, the most respected. The verse:

> "St. Swithin's day, if thou dost rain,
> For forty days it will remain.
> St. Swithin's day, if thou be fair,
> For forty days 'twill rain nae mair,"

is a fair illustration of this class. Candlemas Day, too, comes in for more than its share of attention:

> "If Candlemas Day be fair and clear,
> There'll be two winters in that one year,"

and,

> "If Candlemas Day be clear and bright
> Winter'll have another flight;
> But if Candlemas Day be clouds and rain,
> Winter is gone, and will not come again,"

suggests the supposed dominance of this day over the weather of late winter and early spring.

Christmas, as might be expected, was not neglected by the primitive weather man. An old English proverb says:

> "If the ice will bear a man before Christmas, it will not bear a man afterwards,"

and again,

> "A green Christmas makes a full graveyard,"

and,

> "A green Christmas indicates a white Easter."

We must interpret such proverbs, in justice to their framers, as indicating some sort of fixed relation between one time of year and another and not as indicating any supernatural influence of the day itself, or even of its patron saint. Undoubtedly, too, the relation discovered and asserted in the proverb is founded upon observation and is, in the long run, a true one.

Weather periodicity and a certain rhythm in the occurrence of storms have been demonstrated beyond a doubt, and many of these special day-predictions are undoubtedly among the most valid of the whole mass of weather lore. It must, however, be admitted that a still larger number of them seem to have but an accidental origin in doggerel verse, and show nothing more than an insatiable desire on the part of some one to poetize. Of this, no example shows a stronger tendency than the following, taken from the *Harleian Manuscript* in the British Museum. The allusion in each verse to thieving and stealing, forms an interesting commentary upon the times in which it was written:

"Lordlings, all of you I warn:
If the day that Christ was born
Fall upon a Sunday,
The winter shall be good I say
But great winds aloft shall be;
The summer shall be fair and dry
By kind skill and without loss,
Through all lands there shall be peace
Good time for all things to be done
But he that stealeth shall be found soon;
What child that day born may be,
A great lord he shall live to be.

"If Christmas day on Monday be,
A great winter that year you'll see,
And full of winds, both loud and shrill,
But in the summer, truth to tell,
Stern winds shall there be and strong,
Full of trumpets, lasting long;
While battles they shall multiply
And great plenty of beasts shall die;
Those that day be born I wean,
They shall be strong each one, and keen.
He shall be found that stealeth aught
Though thou be sick, thou diest not.

"If Christmas day on Tuesday be,
That year shall many women die,
And that winter grow great marvels;

Ships shall be in great peril.
That year shall kings and lords be slain,
And many other people near them.
A dry summer that year shall be
As all that are born therein shall see;
They shall be strong and covetous.
If thou steal aught, thou losest thy life,
For thou shall die through sword or knife,
But if thou fall sick 'tis certain
Thou shall turn to life again.

"If Christmas day, the truth to say,
Fall upon a Wednesday,
There shall be a hard winter and strong,
With many hideous winds among.
The summer merry and good shall be,
And that year wheat in great plenty;
Young folks shall die that year also,
And ships at sea shall have great woe.
Whatever child that day is born is,
He shall be doughty and gay, I wis,
And wise and crafty also of deed,
And find many in clothes and bread.

"If Christmas day on Thursday be,
A windy winter you shall see;
Windy weather in each week
And hard tempests strong and thick.
The summer shall be good and dry,
Corn and beasts shall multiply;
That year is good, lands for to till;
Kings and princes shall die by skill.
If a child that day born shall be,
It shall happen right well for thee;
Of deeds he shall be good and stable,
Wise of speech and reasonable.
Whoso that day goes thieving about,
He shall be punished without doubt;

And if sickness that day betide
It shall quickly from thee glide.

"If Christmas day on Friday be
The first of winter hard shall be;
With frost and snow, and with great flood;
But the end thereof, it shall be good.
Again, the summer shall be good also;
Folk in their eyes shall have great woe;
Women with child, beasts, and corn,
Shall multiply and be lost none.
The child that is born on that day,
Shall live long, a bachelour be alway.
Who stealeth aught shall be found out;
If thou be sick, it lasteth not.

"If Christmas day on Saturday fall,
That winter's to be dreaded by all;
It shall be so full of great tempest,
That it shall slay both man and beast;
Great store shall fail of fruit and corn,
And old folk die many a one,
That woman that day of child doth travail,
She shall give birth in great peril;
And children born that day by faith,
In half a year shall meet with death.
The summer shall be wet and ill;
Thou shalt suffer if aught thou steal
Thou diest if sickness do thee take."

So far as I know, nothing in the literature of weather lore expresses more fully its degeneracy than the preceding, unless it be the one to follow, which truly out-Herods Herod in its attempt to leave nothing unsaid which might have a bearing on the question of a Sunday Christmas. We are truly to be congratulated that the remaining days of the week were not desecrated by the prophetic rhymster. The source of the verse is the same as the preceding:

"If Christmas day on Sunday be,
A troublous winter you shall see,
Mingled with waters strongly;
Good there shall be without fable
For the summer shall be reasonable,
With storms at times among.

"Wines that year shall be good,
The harvest shall be wet with flood,
Pestilence shall fall on many a country;
Ere that sickness shall have passed,
And while great tempests last,
Many young people dead shall be.

"Princes that year with iron shall die,
There shall be changing of many lords high,
Amongst knights, great debate,
Many tidings shalt come to men,
Many wives shall be weeping then,
Both of poor and great estate.

"The faith shall then be hurt truly
For divers points of heresy
That shall then appear,
Through the tempting of the fiend;
And divers matters unkind
Shall bring great danger near.

"Cattle shall thrive one and the other
And oxen, they shall kill each other
And some beasts shall die:
Both fruit and corn will not be good,
Apples will be scarce for food,
And ships shall suffer on the sea.

"That year, on Monday, without fearing
All things well thou mayst begin,
They shall be profitable.
Children that on this day are born
I'faith shall mighty be and strong
Of wit, full reasonable."

CHAPTER III

ANIMAL WEATHER LORE

So extensive is the literature of weather proverbs that it would be possible to extend the study of them almost indefinitely. Such a study, at least in so far as those proverbs have to do with the supposed effect of one meteorological condition upon another, would, however, have hardly any scientific value, and would be of little interest, except to the morbidly curious. Yet there is a large field of weather wisdom, not yet touched upon, which is extremely suggestive to the comparative psychologist, and from the point of view of weather influences, especially interesting. This is the field of animal lore as revealed by weather proverbs. Its extent is something enormous. It would seem as if every animal, and even plant, with which man is familiar had been accredited, by some one, with especial power of prognostication and boldly championed in prose or verse. In these records, we have the earliest note books of the comparative psychologists, and many of them show clean pages of truth, even under the higher illumination of modern scientific method. Yet we cannot deny that the rhyming craze has entered into the problem, and that undoubtedly many writers have been more willing to spoil truth than rhythm; but on the whole this class of weather lore is comparatively trustworthy.

Its whole basis is psychological. Nature has provided many of the lower animals, as a means of protection, with more delicate sensory organs than man. That such an hyperaesthetic power is a necessity with them would hardly be denied by any one who has been in a position to observe the terrible devastation which nature, in some of her moods, brings about. An English writer has recently touched upon this point in "The Spectator." (Vol. 85, p. 883, et seq.).

"In this country, wet springs and summers seem to affect most forms of animal life. There are few butterflies or moths. All young birds suffer, especially game. Rabbits and hares die of fluke and dysentery; calves, sheep and lambs of various ailments. Myriads of wild birds' eggs are addled or the young birds die in the nests. Even rats decrease. Fish do not thrive, because there are few insects. Even kingfishers decrease on the Thames, because the wet soaks into the holes in which they breed. There is reason to conjecture that a wet summer around our coast actually reduces the number of fish in the sea and of marine life generally. This may seem a paradox, but it is borne out partly by the increase of marine life after dry years, partly by the recent discoveries as to the hatching and life of the spawn of sea creatures.

"The season of 1900, for instance, has seen the most teeming marine life known for years around our shores. But the early summer of 1900 was exceptionally cold and wet. So it was, and it destroyed the young partridges, rabbits and hares. But the sea creatures are not made in one summer like the partridges. The herrings, of which the record catch was made, the bass which were caught in thousands off Dover, the innumerable cuttle fish, the solid shoals of mackerel taken off the Irish coast, perhaps were adult fish, and hatched in unusual numbers in *the three previous hot summers,* when no cold rains were chilling the surface of the sea and keeping down temperatures. For it is on the surface of the sea that the untold millions of eggs of most of the food fish float, and it is there, too, that the minute creatures swim and breed, and lay their invisible eggs on which the rest of the sea fish feed. Thus rain and cold may be as fatal to the life of the ocean, as they are to the life on dry land. Wet weather spoils even the harvest of the sea."

Although this description has to do with long continued drought or dry weather, which the members of the animal kingdom could neither escape nor modify, even if they foresaw its approach, there are numerous weather changes of shorter duration, to make preparation for which means all the difference between life and death, or at least between a winning and losing struggle for existence. For some of the larger carnivora, a severe storm means perhaps the loss of so much food as to reduce the animal to a point of weakness which brings about defeat in his struggle with competition. It is a well known fact that for the mother bird to be absent from the nest during a severe storm would mean the utter destruction of the young in the cases of many species of the feathered kingdom; while to many of the insect tribe, the state of the weather for even a day may determine the question of life or death. But nature has recognized all this dependence and has given to these creatures some subtile sense, unknown and unpossessed by us, by which minute changes in atmospheric condition can be appreciated, and actions determined accordingly. In response to some organic feeling brought about by this peculiar state of the atmosphere, the animal does certain things, undoubtedly as a purely reflex act, not knowing why; still he does them. Man observed these peculiarities of action and noted them. But the atmospheric state which was the stimulus of the activity in the animal, bore a certain fixed relation in time to some other which was to follow, *i. e.,* wind, rain or storm, was not in any proper sense the cause of it, but simply one of the stages in its development. For man to discover the true relation between one atmospheric condition, as indicated by the activity of the animal, and the succeeding atmospheric condition as expressed in the storm, was only a step farther in the process. This he did with more or less accuracy, and it has descended to us as the weather lore of animals.

When the observations have been carefully made, the results are trustworthy; but we have reason to believe that our forefathers of weather fame were more frequently wide than careful observers of the events of nature.

Dr. C. C. Abbott (Proc. Trenton Nat. Hist. Society, Feb. 13, 1883) showed that the autumnal habits of certain animals that are supposed to be indicative of the character of the coming winter, and that have in consequence been made the basis of an extended weather lore, could not be depended upon. Dr. Abbott had kept a careful record, extending over twenty years, regarding the building of their winter homes by muskrats, the storing of nuts by squirrels, and other habits of these mammals, and had found that the activities referred to bore no relation to the character of the coming winter. Of the belief that the opossum, before a severe winter, burrows deep into the ground, while in expectancy of a mild one, he occupies a hollow tree, he says:

"This seems very reasonable, and would pass admirably as a weather sign but for one important circumstance. While you may find one or more in a tree, your neighbor may find as many in the ground. I have known this to be the case more than once. Under these circumstances, meet your neighbor at the fence and compare notes. What about the winter?" Nevertheless, the supposed prescience of the opossum and his friends has been made the basis of much prophecy.

"Cats have the reputation," says Dunwoody, "of being especially weather wise, an old notion which has given rise to a most extensive folk lore. It is almost universally believed that good weather may be expected when the cat washes herself, but bad when she licks her coat against the grain, or washes herself over her ears, or sits with her tail to the fire. As, too, the cat is supposed not only to have a knowledge of the state of the weather, but a certain share in the arrangement of it, it is considered by sailors most unwise to provoke a cat. Hence they do not much like to have a cat on board at all, and when one happens to be more frisky than usual, they quote a saying that the cat has a gale of wind in her tail. A charm often resorted to for raising a storm is to throw a cat overboard; but according to a Hungarian proverb, as a cat does not die in the water, its paws disturb the surface—hence the flaws on the surface of the water are called 'cat's paws.' In the same way, also, a large flurry in the water is called a 'cat's skin;' and in some parts of England a popular name for the stormy northwest wind is the 'cat's nose.'" Besides sayings based upon the conditions mentioned above, there are many other cat-activities which are supposed to be portentous. "If the cat is basking in the sun in February it must go again to the stove in March" (German), is based upon the truth already mentioned as the foundation of much weather wisdom, that the second month of the year is too early to expect a settled spring.

That cats with their tails up, and hair apparently electrified, indicate an approaching wind, is a belief which is based upon sound physics (see page 127); as it is certain that a brisk wind sets up an electrical state in the atmosphere which might well show itself in such a substance as cat's fur, even beyond the actual limit of atmospheric movement, hence acting as a premonition of approaching wind. In the same way, that cats claw table legs, tree trunks, etc., before a storm, is but an allusion to their hyperaesthetic appreciation of the peculiar atmospheric conditions just preceding a violent change from fair weather.

The other domestic animals, probably because they have been easy of observation, have come in for a large share of attention:

"When the ass begins to bray
Be sure we shall have rain that day.
When the donkey blows his horn
'Tis time to house your hay and corn,"

and,

"Hark, I hear the asses bray,
We shall have some rain to-day,"

might have been written by Theophrastus, and certainly agree well enough with other things written by that author. Sheep, according to this tradition, show even more precisely by their actions what is to follow than do their long-eared barnyard friends. Thus old sheep are said to eat greedily before a storm, and sparingly before a thaw; but when they leave high ground and bleat much in the evening and during the night, severe weather is expected. In winter when they feed down hill, a snow storm is looked for; when they feed up the burn, wet weather is near.

From the earliest times birds have been considered among the most trustworthy of all animal prognosticators. It is plain to see why this is so, both from the conspicuousness of their position in the heavens and their supposed intimacy with the skyey influences. Hardly any bird known to man is left out of the catalogue: the domestic fowls, ducks and geese, pigeons, the swan, the crane, the stork, as well as the smaller birds, are all studied as portents. Perhaps of them all, the rook has received the most attention. In Scotland, there is current an analysis of his behavior which seems to lack nothing, unless it be the truth, though on that point I am ignorant.

"The low flight of rooks indicates rain. If they feed fast and hurry over the ground in one direction, and in a compact body, a storm will soon follow. When they sit in rows on dykes and palings, wind is looked for; when going home to roost, if they fly high, the next day will be fair, and *vice versa*. If when flying high they

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dart down and wheel around in circles, wind is foreshown. In autumn and winter, if, after feeding in the morning, they return to the rookery and hang about it, rain is to be expected."

But the acme of credulity is reached in weather proverbs concerning the leech. This animal is a conspicuous figure in the prognostications, although the smaller fish, by the frequency of their coming to the top of the water, are said to be modest competitors for honors. The prophetic instinct of the leech has been the subject of learned treatises, and at least two whole volumes have been written about him. One of these explains in full a wonderful instrument which the author and inventor, Dr. Merryweather, called the "tempest prognosticator," and for which he claimed wonderful things. Its success depended upon the supposed activity of the leech before a storm; and the instrument was so arranged that the little animal, by his contortions at such a time, was made to ring a bell, and thus give an alarm. The author states in his book that he could make a single leech ring the great bell of St. Paul's, and by so doing, allow time for preparations for the coming torrent, and thus be instrumental in preventing much discomfort and pecuniary loss. I do not know how successful the learned doctor was in introducing this invention to the public; but if his success were at all commensurate with his faith in its efficacy, or his ingenuity in its construction, he must have died wealthy. The exact symptomology of the leech as set down by him, is as follows:

"Before high winds, it moves about with much celerity. Previous to slight rain or snow, it creeps to the top of the bottle, but soon sinks; but if the rain or wind is likely to be of long duration, the leech remains a longer time at the surface. If thunder approaches, the leech starts about in an agitated and convulsive manner."

Even the vegetable world has not escaped the attention of the weather prophet, and many plants undoubtedly do give evidence of the approach of stormy weather long before it actually takes place. The pink-eyed pimpernell, or ploughman's weather glass, is better understood in some parts of England than the readings of elaborate instruments and is, perhaps, as trustworthy, besides possessing the advantage of being in the fields where wanted. Many of the commoner inanimate things of the household, like drawers, chairs, tables and doors, as we all very well know, react in peculiar ways to meteorological changes and have been introduced in various ways by the weather poet.

One of the most complete catalogues of such influences extant is the note—written in meter—by the renowned Dr. Jenner to a friend, expressive of regret that an anticipated hunting excursion would probably have to be given up:

"The hollow winds begin to blow;
The clouds look black, the glass is low.
The soot falls down, the spaniels sleep,
And spiders from their cob-webs peep.
Last night the sun went pale to bed,
The moon in halo, hid its head;
The boding shepherd heaves a sigh
To see a rainbow in the sky.
The walks are damp, the ditches smell;
Closed is the pink-eyed pimpernell.
Hark! How the chairs and table crack!
Old Betty's joints are on the rack.

Loud quack the ducks; the peacocks cry:
The distant hills are looking nigh.
How restless are the snorting swine;
The busy flies disturb the kine;
The cricket too—how sharp he sings!
Puss on the hearth, with velvet paws,
Sits, wiping o'er her whiskered jaws.
Through the clear stream the fishes rise,
And nimbly catch the incautious flies.
The glowworms, numerous and bright,
Illumed the dewy dell last night.
At dusk the squatted toad was seen
Hopping and crawling o'er the green.
The whistling wind the dust obeys,
And in the rapid eddy plays.
The frog has changed her yellow vest,
And in a russet coat is drest.
Though June, the air is cold and still;
The blackbird's mellow voice is shrill.
My dog, so altered in his taste,
Leaves mutton bones, on grass to feast.
And see yon rooks, how odd their flight!
They imitate the gliding kite,
And seem precipitate to fall,
As if they felt the piercing ball.
'Twill surely rain, I see with sorrow;
Our jaunt must be put off to-morrow."

These allusions, as the concluding lines indicate, have to do only with an approaching storm; though it is, I believe, noticeable that the whole class of animal and plant proverbs deal almost entirely with such predictions and those of the seasons.

Vergil, although writing nearly twenty centuries ago, leaves little to be said upon the question of weather proverbs. With such a start, we can hardly wonder at the extent of weather lore:

"Wet weather seldom hurts the most unwise;
So plain the signs, such prophets are the skies.
The wary crane foresees it first and sails
Above the storm, and leaves the lowly vales.
The cow looks up, and from afar can find
The change of heaven, and sniffs it in the wind.
The swallow skims the river's watery face;
The frogs renew the croaks of their loquacious race;
The careful ant, her secret cell forsakes
And drags her eggs along the narrow tracks.
At either horn, the rainbow drinks the flood.
Huge flocks of rising rooks forsake their food,
And crying, seek the shelter of the wood.
Besides the several sorts of wailing fowls,
That swim the seas, or haunt the standing pools,
The swans that sail along the silvery flood,
And dive, with stretching necks to search for food,
Then lave their backs with sprinkling dews in vain
And stem the stream to meet the promised rain.
The crow, with clamorous cries, the shower demands,
And single, stalks along the desert sands.
The nightly virgin, while her wheel she plies,
Foresees the storm impending in the skies,
When sparkling lamps, their sputt'ring light advance,
And in their sockets, oily bubbles dance.
Then after showers, 'tis easy to descry
Returning suns and a serener sky.
The stars shine smarter and the moon adorns
As with unborrowed beams, her sharpened horns.
The filmy gossamer now flits no more,
Nor halcyons bask on the short sunny shore;
Their litter is not tossed by sows unclean;
But a blue, draughty mist descends upon the plain;
And owls, that mark the setting sun declare

A starlight evening and a morning fair.
Above the rest, the sun, who never lies,
Foretells the change of weather in the skies;
For if he rise, unwillingly to his race,
Clouds on his brow, and spots upon his face;
Or if through mist, he shoots his sullen beams
Frugal of light in loose and struggling streams,
Suspect a drizzling day . . . .
If fiery red his gloomy globe descends
High winds, and furious tempests he portends:
But if his cheeks are swollen with livid blue,
He bodes wet weather by his watery hue;
If dusky spots are varied on his brow,
And streaked with red, a troubled color show,
That shallow mixture shall at once declare
Winds, rains and storms, and elements at war."

CHAPTER IV

WEATHER INFLUENCES IN LITERATURE

What the effect of one meteorological condition may be upon another we care but little and must, in any event, leave their special study to the meteorologist. The effects of such conditions upon members of the lower animal kingdom, however, take on quite another type of interest, since we have, with the study of them, entered the realm of the mind. The relation between cause and effect is no longer, of a certainty, merely physical, but is psychological with all which that implies. Yet paramount to our interest in the psychological problem of weather influences upon members of the lower animal kingdom comes that in the problem of those same influences upon man. It is, in fact, the only phase which has much more than a morbidly curious interest. We are creatures of our environment, reflecting in our behavior, even to the slightest degree, the changes rung in by the weather-man, and the problem takes on an ethical significance. But is man influenced in his behavior to any appreciable extent by the weather? On strictly *a priori* grounds, reasoning from pure analogy, we should be inclined to answer in the affirmative, for first, it is without doubt true that the lower animals, —our somewhat distant relatives,—are susceptible to weather influences, as shown by weather lore; and second, it is equally true that mankind, as a race, is affected to a very marked degree by climate, which is, after all, nothing but prevailing weather. What is then a family trait,—considering the entire animal kingdom as a family,—we might expect to find in any single branch of the family, and what is true for a totality of causes is at least likely to be true for any single cause covered. But we recognize that this line of argument *proves nothing*. Proof, even if it be possible in a question of this sort, must be *a posteriori*. It is not enough to presume that it should be true. Two lines of procedure are open to us in the pursuit of the problem: First, that of finding out what our friends and others have to say regarding the influence of the weather upon themselves and others within the field of observation; and, second, a study of the actual behavior of large numbers of human beings under varying meteorological conditions. The first method is essentially literary and must depend for the most part upon citations from literature, which are supposed to express the author's feelings; the second is purely statistical, and must, in order to be approximately valid, include a sufficient number of data to eliminate the accidental error common to all inductive problems. To this latter phase of the problem of weather influences, this volume is principally devoted, although material is not lacking in literature for the discussion of the former. A writer in one of the British magazines has said:

"There are many persons who are simply victims of the weather. Atmospheric influences play upon them as the wind plays upon the strings of an Aeolian harp, with the difference that the harp never utters discord in reply. A leaden sky weighs upon them with a crushing weight, and suggests all manner of unpleasant anticipation. Then the gloomy side of life comes out. The bitter sayings of friends are brought to mind. The old groundwork of forgotten quarrels is remembered; uneasy questions arise with regard to the future. One gets tired of life. A sort of indefinite dread is the general mental influence, a faint continuation of the superstitious fancies which mark the childhood of nations and men."

Who has not, at times, felt this influence? In all the vigor of perfect health, it may hardly be recognized; but when the vital forces are depleted by the exhausting effects of a long nervous or physical strain, the influence of this phase of cosmical environment is sure to make itself known. Then comes those days when everything is sure to go wrong. How inconsiderate are our friends, when the east wind blows, and the skies are heavy! How dangerously doubtful seems to-day the venture which yesterday, in the bright sunlight, seemed certain of success!

General experience teaches most people that the body and the mind are both liable to be affected by the "skyey influences." Some, indeed, like Dr. Johnson, may affect to treat this with ridicule, and the strong and robust may scarcely be sensible of the changes which the state of the weather may effect in them, but the more sensitive and susceptible are fully alive to the facts, so much so, indeed, as to become in some measure, living barometers. Who has not, in some part of his life, at least, experienced the depressing effects of a dull, rainy day in his spirits?—or who has not, on the contrary, felt the exhilaration of dry air and bright glowing sunshine? At times, even in good health, a state of mind comes over us in which everything appears dark and gloomy; in which little ills are magnified into terrible evils, and in which casual annoyances seem as if they were to be perpetual. All this may endure for a day, but to-morrow's sun rises bright and cheerful; a wonderful change has come over our spirits,—hope and joy have suddenly taken the place of our sorrows. How much is man thus a creature of circumstances and how prone is his mind thus to be unnecessarily agitated!

Certain temperaments are more liable to be affected by the weather than others. Invalids and all delicate persons are more "tremblingly alive" to its changes than are the robust and healthy. While one shivers from the northern breeze and can tell from his sensations, the moment he gets out of bed, from what quarter the wind blows, another, less alive to minute feelings, laughs at all such, and like the renowned Tam o' Shanter, "never minds the storm a whistle."

"I feel all wrought up, and fit for nothing, this kind of weather," is a statement we are all familiar with during the dry, windy spells to which our climate occasionally treats us; and we teachers are sure that during certain phases of the weather, our pupils (of course it cannot be ourselves) are too exasperating for endurance, while a change in the meteorological conditions brings with it a smoothness and tranquillity of spirit which form a marked contrast. That the weather has a pronounced effect upon physiological conditions, few afflicted with rheumatism or diseases of its nature would for an instant doubt. The fact was so well recognized in earlier times as to have worked itself into weather lore, and we have the proverbs:

> "When rheumatic people complain of more than ordinary pains in the joints, it will rain."
>
> "If corns, wounds, and sores itch and ache more than usual, rain is sure to fall shortly,"

and,

> "A coming storm, yon shooting corns presage,
> And aches will throb, your hollow tooth will rage."

That the effects are quite so marked upon mental states might be questioned, but that it has an effect of considerable importance is recognized, even by the matter-of-fact business men of our large mercantile concerns. For instance, during London fogs, and on days when the weather is particularly depressing, in the Bank of England, certain sets of books, an error in which would be cumulative and produce disastrous results further on, are locked up, and the clerks set at tasks less intricate and important in character. Experience has taught those in charge that the percentage of error increases manifold during such climatic conditions, and that it is money in pocket to yield to them. The same necessity for cessation of certain lines of work during bad "spells of weather," is recognized by the larger banking institutions in New York and the other eastern cities, and a rotation of work in conformity to them is rigidly observed. It has been the universal reply, too, by the superintendents of prisons and asylums for the insane, to whom I have appealed for their opinion upon the subject, that the persons in their charge varied so markedly with the meteorological conditions that no man who ever had their experience could for a moment doubt that the relation between weather and emotional states was any other than cause and effect. When asked, however, what definite conditions of the weather tended to be most productive of emotional abnormalities, no satisfactory answer could be made, and we were as much at sea as ever.

A principal of one of the large boarding-schools for boys, a Quaker school in Eastern New York, made some very interesting statements corroborative of the general belief I have already stated. They were given me by a friend, who was for some years an instructor in the school just mentioned. He said the principal would occasionally come to him, with the assurance of one who knows, and caution him to look out for the boys, and particularly certain boys whom he called by name, saying, "There is likely to be trouble to-day." This had continued for some time, and every warning had proved timely, when the instructor's curiosity with regard to the principal's seeming prescience led him to appeal to his superior for the secret. The answer was that a careful observation for long years had proved to him that certain definite conditions of the weather, as revealed to him by the barometer of a gouty foot, brought with them, or were followed by a tendency to unruliness on the part of the boys. He also stated that his belief that the weather produced these marked effects upon his pupils had been intensified of late, since he had been suffering from a severe attack of insomnia, during which he had spent many nights walking the long corridors of the dormitories. Here, on those nights which his previous experience had led him to believe would be followed by emotional abnormalities, he would hear the boys, from whom he was separated only by badly fitting doors with open transoms above them, tossing upon their beds in imperfect sleep, or moaning and talking in a manner quite unusual to them on nights when the weather was different.

The head of a factory employing 3,000 workmen has said: "We reckon that a disagreeable day yields about ten per cent. less work than a delightful day, and we thus have to count this as a factor in our profit and loss account."

Furthermore, certain writers, like Gilbert White, Thoreau, Richard Jeffries and others, who, within the circle of the horizon seen from their own windows, have noted and preserved every prognostic, every breath of change, every modification of the weather, its relation to their own habits and health of their own four-footed live creatures, to the coming and going and mating and nesting of the birds, the blossoming of flowers and the fruit and seed time of the harvest, have discovered the touch of nature that makes the whole world kin, and have gone far to secure immortality for themselves. Thus, Dorothy Wordsworth's journal, to which the poet turned as to this commonplace book, was chiefly a chronicle of the weather. "Tremendous wind," we find. "The snow blew from Helvellyn horizontally like a snake. We came in late. He had been surprised and terrified by a sudden rushing of the winds, which seemed to bring earth and sky and lake together as if the whole were going to enclose him," and on and on for pages.

So marked has been the confessed influence of the sun upon men of literary genius, that we might almost agree with Lombroso that men of genius, in common with the vegetable world, need a surfeit of its influence for full fruition. Shelley loved to expose himself to its intensest ardor, and many of his best verses were penned upon the roof of his house near Leghorn, entirely unscreened from the pelting rays of the hottest of Italian suns. Byron was no less a sun-worshiper.

"I am always more religious on a sunshiny day," he wrote, "as if there were some association between our internal approach to greater light and purity, and the kindler of this dark lantern of our external existence." Charles Lamb, too, that inveterate lover of London with all its smoke and fogs, needed only a taste of something better to be filled with enthusiasm. On the occasion of his one brief journey to France and its southern skies, he cried out, "I hold with the Persian," and nothing less than an August noon with a sweltering sky overhead could meet his craving. At such a time it was that he felt himself immortal, "as strong again, as valiant again, as wise again, and a great deal taller." Benvenuto Cellini has left us a touching account of his yearning after the sun during a period of imprisonment. At length his consuming wish brought about its own fulfillment, for in a vision he was led forth into the street from his dark lair by a beautiful youth and saw the sunlight in the wall above his head, and then, in answer to his prayer, the very sun itself. Dazzled, he closed his eyes; but repenting, he opened them again, and gazing steadfastly upon it, exclaimed, "Oh, my sun, for which I have passionately yearned! Albeit yon rays may blind me, I do not wish to look upon anything but this." Lady Mary Wortley Montague, a woman for whom Wordsworth expressed the highest admiration, seems to have been possessed of a passion hardly less intense. "For my own part," she exclaims, "who am more passionately fond of Phoebus than ever Clymene was, I have some thought of moving to Africa that I may feel him before I die, which I shall do as surely as your olive trees, if I have much longer to sigh for his absence." And the poet, Moore, who could stretch his imagination no further than to wish for all mankind no joy but this:

> "To sit in sunshine calm and sweet,
> It marks a world too exquisite
> For man to leave it for the gloom,
> The deep cold shadow of the tomb."

Rousseau, too, like Shelley, loved to expose his bare head to the sun's fiercest rays, even in the hottest weather, declaring that it did him good. Beethoven, if he could not get enough of the sun in them, would change his lodgings. But what Goethe has called the sun thirst has never been felt by any more fully than by Walt Whitman. "I love the splendid, silent sun," he says. And the assertion was no mere figure of speech, for much of his *Leaves of Grass* was written while prone upon the white sands of a Long Island beach, with such a sun as only seems to blaze there. He would, as he naïvely confides to his readers, "drink the sun's rays in at every pore." Southey, also, strangely foreshadows the cravings of our poet philosopher, when he writes: "I do not know anything more delightful than to lie on the beach in the sun, and watch the rising waves, while a thousand vague ideas pass over the mind, like the summer clouds over the water." Elsewhere he declares himself "a greenhouse plant, pining for want of sun," and in acknowledging his eager desire for the consulship at Cintra, a place where the sun is so powerful as to frequently cause blindness, he writes:

"In truth, I have been too long abroad to be contented with England. I miss the sun in heaven, having been upon a short allowance of sunbeams for the last ten days; and if the nervous fluid be the galvanic fluid, and the galvanic fluid the electric fluid, and the electric fluid condensed light, zounds! what an effect must these vile, dark, rainy clouds have upon a poor, nervous fellow like me, whose brain has been in a state of high illumination for the last fifteen months."

Yet as ardent an admirer of the sun god as was Southey, Shakespeare, if we may judge by the number of his weather allusions, felt even more strongly the "skyey influences" than has any other great author. His feeling was, however, rather *heliophobic* than the reverse. Shakespeare seemed firmly of the belief that the sun, and its heat, were sure and certain stimulators of the angry passions, a belief, let me say, which studies discussed later in this volume seem fully to corroborate.

In the third part of Henry VI. he makes King Edward, who is trying to arouse his fellows to attack Warwick, say:

> "The sun shines hot; and if we use delay
> Cold biting winter mars our hoped for May,"

and again,

"The day grows wondrous hot—some airy devil hovers in the sky."

And in another play (*Hamlet*):

> "When in your motions you are hot and dry,
> As makes your bouts more violent."

Each of the following quotations serves to emphasize the impression:

"But look you pray, all you that kiss my lady peace at home, that our armies join not in a hot day." [2 *Henry IV*. 1. 2.]

"If the day be hot, and I brandish anything but a bottle, I would I might never spit white again." [*Ibid.*]

"If there come a hot June, and their civil buffeting hold, we shall buy maidenheads." [1 *Henry IV*. 11. 4. 397.]

"And in the hottest day prognostication proclaims, shall he be set against a brick wall." [*Winter's Tale,* IV. 4. 417.]

Yet his most striking example of sun fear is in *Romeo and Juliet,* the entire plot of which he hinges upon the influence of a hot day. The fatal brawl in which Tybalt is slain is precipitated by the effect of the temperature upon the principal actors. Benvolio realized that possibility, and in attempt to restrain his lively companion, said:

"I pray thee, good Mercutio, let's retire:
The day is hot, the Capulets abroad,
And if we meet, we shall not 'scape a brawl,
For now, these hot days, is the mad blood stirring."

But his warning was disregarded. As a result, when the Montagues and the Capulets met, they fought. Mercutio lost his life; Romeo was banished for slaying Tybalt; Juliet was forced to take the potion to avoid a hateful marriage with Paris during her lover's absence, and was discovered, apparently dead, by Romeo, who killed himself; and Juliet awakening, completed the tragedy, "falling dead on the body of her lover." Terrible results, these, from the effects of one hot day!

That Shakespeare held the south wind in strange disrepute, is shown by the following, though in this he varied from his contemporaries, if we may believe the weather lore of his time:

> "All the contagions of the south light on you." [*Coriolanus*, I. 8.]
>
> "The south fog rot thee."
>
> "Like foggy south, puffing with wind and rain."

It is possible that in Shakespeare's time, fens and marshes were much more abundant in the south of England than they are now, and that winds from that direction may have been laden with malarial and other noxious germs, making them particularly dangerous. In other respects, however, we cannot but pronounce the epithets which Shakespeare applies to the south wind particularly libelous. Moreover, Shakespeare had no love for the winter:

> "You and you are true together
> As the winter to foul weather,"

he says in *As You Like It*, V. 7.

Beside these undoubted reflections of the great author's unborrowed feelings of weather influence, he has also used from time to time the current lore of the period. We know that the cry of the owl was held as an omen or a sign of stormy weather, and we read (*Macbeth*, II. 5):

> "The obscene bird
> Clamoured the livelong night."

The notion of the unwholesomeness of the night air was prevalent, and we find him saying (*Julius Caesar*, III. 3):

> "To dare the vile contagion of the night
> And tempt the rheuming and unpurged air."

And again, the hush that precedes the storm is noted:

> "But as we often see against some storm
> A silence in the heavens, the rack stand still,
> The bold winds speechless and the owl below
> As hush as death—anon the dreadful thunder
> Doth rend the region." [*Hamlet*, II. 7.]

The attention of mankind in the early history of the world naturally directed itself to the science of meteorology. The ablest of ancient philosophers advocated the doctrine of atmospheric astrology. The most general principle observed was the position of the sun toward the planets. It caused the weather to be of the nature of the planet it was in conjunction with or parallel to at the particular period of time. After the conjunction the next most powerful influence upon the matter was supposed to be the period when the sun was in an opposition aspect to an evil planet. Of this astrological idea, Shakespeare makes peculiar use by causing one aspect of the heaven to be in harmony with the mental condition or fortunes of his characters. Thus we find:

> "Stars with trains of fire and dews of blood,
> Disasters in the sun; and the moist star,
> Upon whose influence Neptune's empire stands
> Was sick almost to doomsday with eclipse,"
> [*Hamlet*, I. 1. 117.]

And,

> "No natural exhalation in the sky,
> No scope of nature, no distempered day,
> No common wind, no customed event;
> But they will pluck away his natural cause
> And call them meteors, prodigies and signs

Abortives, presages and tongues of heaven
Plainly denouncing vengeance upon John."

[*Hamlet*, III. 4.]

Again,

"But when the planets
In evil mixture to disorder wander,
What plagues and what portents! what mutiny!
What raging of the sea! shaking of earth!
Commotion in the winds! fights, changes, horrors,
Divert and crack, rend and deracinate
The unity and married calm of states
Quite from their fixture."

[*Troilus and Cressida*, I. 3. 94.]

"Dazzle mine eyes, or do I see three suns?
Three glorious suns, each one a perfect sun;
Not separated with the racking clouds,
But severed in a pale clear shining sky—
In this the heaven figures some event."

[3 *Henry VI*. 2. 1.]

"The sun sets weeping in the lowly west,
Witnessing storms to come, woe and unrest."

[*Richard II*. II. 4.]

Ptolemy says: "If the sun have a wavering or fiery orb, or seems to emit or attract red rays, or if he be accompanied in any one part of the clouds called parhelia, or other reddish clouds of extended figure in the form of long rays, he then portends violent winds, chiefly liable to arrive from those parts in which the said phenomena may have shown themselves." Shakespeare was not less keenly observant, as is shown by the following:

"*King*. How bloodily the sun begins to peer
Above yon brisky hills! the day looks pale
At his distemperature.

Prince. The southern wind
As doth the blushing, discontented sun
From out the firey portal of the east,
When he perceives the envious clouds are bent
To dim his glory, and to stain the tract
Of his bright passage to the occident."
[*Richard II.* 3. 6.]

"How bloodily the sun begins to peer,
Above yon brisky hill! The day looks pale
At his distemperature.
The southern wind
Doth play the trumpet to his purposes,
And by the hollow whistlings in the heavens
Foretells a tempest and a blust'ring day."
[*Henry IV.* Pt. I, V. 1.]

"The skies look grimly,
And threaten present blusters;
The heavens with that we have in hand are angry,
And frown upon's."
[*Winter's Tale,* III. 3.]

He makes the broken-hearted Elizabeth say:

"All springs reduce their currents to mine eyes,
That I, being governed by the watery moon
May send forth plenteous tears to drown the world."
[*Richard III.* II. 2. 67.]

In *A Midsummer Night's Dream,* III, 1, 203, Titania says:

"The moon, methinks, looks with a watery eye."

It is true that in *King Lear,* Shakespeare makes Edmund ridicule the doctrine of astrological and meteorological necessity as follows:

"This is excellent foppery of the world that, when we are sick in fortune—often the surfeit of our own behavior—we make the

guilty of our disasters the sun, the moon and the stars; as if we were villains by necessity, fools by heavenly compulsion; knaves, thieves and treachers by spherical predominance; drunkards, liars, and adulterers by an enforced obedience of planetary influence."
[*King Lear*, I. 2. 126.]

It is not probable, however, that Shakespeare would take such a character as Edmund as a mouthpiece for his own sentiments; and we may readily believe from his other allusions to the subject that the author put more credence in such influences than the words might signify.

"With Wordsworth and Tennyson began what might be called the weather cult: that is, the entire impenetration of the theme and the motive with the moods of the atmosphere. Dickens was perhaps the first of the modern writers to press fog and rain into his action as characters, powerful as those of flesh and blood; but this plan has been carried to its limit in certain books of Victor Hugo's, Pierre Loti's, Black's, and Craddock's. Maupassant, although generally confining himself to pure dramatic motive, has, in one of his short stories, giving an account of a timid lad, left alone all winter in a hut at the top of Gemini Pass in Switzerland, described the desolation of a world of snow and the freezing cold, with the most striking effect. In fact, all literature from the *Oedipus Colloneus* where the protagonist is summoned by the thunder to meet the god, and the *Odyssey,* where Ulysses is forced to contend with the wind, seas and waves, down to the lastest new novel, is more or less colored by the old indestructible instinct, vitalizing and animating earth and fire and water, seeing spirits frown in the clouds and smile in the sunshine." (E. O. Kirke, *Atlantic Monthly,* Vol. 76.)

CHAPTER V

THE EMPIRICAL PROBLEM

The problem of human conduct, so far as the individual is concerned, is perhaps no nearer a solution today than it was in the time of the Sophists. Certainly no one has been able to formulate a law from which can be predicted what A and B and C will do, under given conditions, for each is sure to react to them in his own peculiar manner; still it is safe to say that the conditions are becoming more and more subjects of study. Yet, however hopeless may be the enigma of the conduct of the individual, that of the mass does not present quite so many difficulties. In human nature there are enough characteristics common to all, to form a working basis; and certain laws of conduct may be formulated for a people, even though they lose their validity when applied to the individual. So-called "Racial Traits" are but the observed effects of such laws, and are generally based upon the influence of some condition of the environment, not infrequently the climate upon the people. The fact that they are not true for every individual does not invalidate them for the race, nor lessen their weight in the prediction of the conduct of the mass under given conditions.

Problems in the ethics of the mass are, however, by their peculiarities, limited in number. Only those may be studied which furnish adequate data of conduct, and in which the condition that is supposed to influence behavior is common to all, if the effects of changes in the condition are to be noted. The influence of bad breakfasts upon the conduct of a people, however potent an ethical factor they may be, could not well form the basis of a statistical study, for the reason that we have no means of knowing how many people, on a given day, were suffering from them. On a morning when A's emotional equilibrium had been ruffled by poor coffee, B's was calm in the enjoyment of a cup of the most savory quality, and with the accidental relations which bad breakfasts bear to one another in point of time, no regular fluctuations in the occurrence of crime can be attributed to them. Among the problems which can be considered are those of an economic nature, for hard times affect all in a community either directly or indirectly, and these problems have received considerable attention. The influence of periods of financial depression upon the prevalence of suicide and certain other crimes is recognized, and the student of social statistics can predict with a reasonable degree of accuracy the effect of such periods upon the people, as shown by the population of our penal institutions. But aside from widespread economic influences and occasional waves of social or religious enthusiasm, the conditions which can be said to influence conduct, are for the most part peculiar to the individual or to a limited number. The one marked exception to this is the weather.

For any given community of limited area, a change in weather conditions means a change in the environment for every inhabitant. If this change in the environment tends to influence conduct, and any statistics of conduct are kept, their study in connection with the records of the weather would disclose the fact. It is just this problem with which our study deals. It is an attempt, by empirical methods, to discover the influence of the weather upon human behavior. It has nothing to do with the permanent or racial effect of prevailing meteorological conditions, but with the immediate and temporary effect of definite fluctuations of those conditions. In other words, not of climate, but of weather.

That certain phases of the weather have a marked effect upon the emotional states of many people cannot for a moment be doubted. As has been shown, fiction bases many of its tragic climaxes upon such a belief, and not a few of the world's greatest thinkers have left a record of such recognized effects upon their own mental states. "Weather Wisdom" is based upon such an influence upon the members of the lower animal kingdom. The newspapers not infrequently touch upon it in attempting to account for an epidemic of suicide or some other crime, and the literature of insanity is full of allusions to it. School teachers, almost without exception, and all those who are in charge of individuals in great numbers—as wardens of prisons—are firm believers in such an influence. Yet most of us do not need the evidence of others to be convinced of its existence; we feel it and make it the scapegoat for all sorts of sins of omission and commission when no other seems conveniently near. The purpose of this paper, then, is not so much to demonstrate *that* such an influence is, as *what* it is, both qualitatively and quantitatively.

The method followed is purely an inductive one and consists of a comparison of the average daily occurrence of certain recorded abnormalities of conduct, with their occurrence under definite meteorological conditions. The data of conduct considered were mostly taken from the records of the New York City Coroner, Chief of Police, and Superintendent of Schools, and consisted of the daily record of suicides, both successful and attempted, of arrests for assault and battery and drunkenness, and of deportment in the City Penitentiary and certain of the public schools; in all, over 600,000 separate occurrences, covering a period of ten years. The meteorological data for comparison were taken from the records of the New York, and Denver, Colorado, stations of the United States Weather Bureau, and comprise the mean temperature, barometer and humidity, the total movement of the wind, the character of day, and the precipitation for each day of the period covered by the data of conduct.

Given, then, facts bearing upon the deportment of the people of a great city for every day for so long a period of time, and exact meteorological condition for each day, by means of a somewhat laborious process of tabulation, it is possible to determine with exactness the weather conditions under which deportment is at its best or worst. In the tabulation, the average daily occurrence for all the days falling under a given meteorological condition was compared with the average daily occurrences for the whole period studied and an excess or deficiency for definite weather conditions noted. This excess or deficiency was ascribed to weather influences. The right to do this might at first thought be questioned;

but a brief consideration will, I believe, show its validity. Let us see: We find marked fluctuations in the daily occurrence of immoral acts in a given community, and must believe these fluctuations to be the effects of some cause or causes, since the time is past when the scientific mind can relegate them to the category of chance. The community is large, and the immoral acts are distributed throughout its length and breadth, so in searching for possible causes, all those which are narrowly local, in affecting but a few individuals, fail to meet the requirements. A's bad breakfast and B's financial failure and C's love affair—then, though all potent in determining the behavior of these individuals on given days, bear but accidental relation to one another in point of time, and in considering 1,500,000 A's and B's and C's for a series of years would fail to be cumulative in effect. There is, in fact, but one condition in the environment which changes simultaneously for all the individuals considered, and that is the weather.

On *a priori* grounds, then, we might expect some definite relation between fluctuations in the weather curve, and that of the occurrence of crime; at least such a thing would be not unreasonable. Yet the *onus probendi* must still rest upon the *a posteriori* method. This we have followed, with the result that a fixed relation is found to exist between the prevalence of certain weather states and an increase in the occurrence of crime, which can be considered hardly other than causal. Yet we must define a little more fully the sense in which the weather can be considered the cause of crime. It is not probable that once in ten thousand times is the weather the immediate and exciting cause of any of the misdemeanors we are considering. We cannot for a moment suppose that a low state of barometer ever drove a man to suicide, though we shall see that suicide is three times as prevalent during conditions of low barometer as during high. In all probability every man whose arrest for assault we are to consider had what seemed to him at the time an all-sufficient excuse for the deed which brought him trouble, and the state of the weather was not in any sense a motive. The question is this: Would the provocation which brought about so violent and disastrous a motor reaction under one condition of weather, have produced the same under another? In other words, are some meteorological conditions productive of emotional states during which an impulse to do an immoral act is less likely to be inhibited than during another? We believe the facts stated in this volume prove this to be the case; but even then we must suppose the direct effect of the weather to be physiological and only through influencing the metabolism of the body, psychological.

The relation between body and mind and the interaction of the one upon the other is known to be of such a nature that, given a physiological change, the mental change is sure to follow and the nexus is in every sense causal. For whatever fixed relations we find then between certain weather states and an increase in crime, we must suppose various and varied provocations peculiar to each individual misdeed and accidental to the weather problem, together with prevailing meteorological conditions which so affect the body that emotional states are produced during which such provocations are likely to be yielded to. In stating these relations, which we have perhaps a logical right to ascribe to "weather effects," I would call attention to the fact that averages in daily occurrence are in every case considered, so the fact that for some of the meteorological conditions there were many more days than for others, and consequently more crimes, does not in any way invalidate the result. Those conditions, however, which occurred so seldom that the probable error from causes accidental to the problem are equal to the indicated influence, are omitted.

The classes of empirical data studied, together with the number of each and the way in which they were obtained, are as follows:

I. Registration in certain of the public schools of New York for the years 1895-96, 118,860.

In this and the other classes of data which have to do with the New York schools the primary departments only were studied for three of the largest schools of the city, viz., Public School No. 93, corner of Amsterdam Avenue and 93d Street; Public School No. 43, corner of Amsterdam Avenue and 129th Street; and Public School No. 10, corner of 7th Avenue and 117th Street. The Primary Departments were studied first, with the intention of similarly considering the Boys' and Girls' Grammar Schools separately, for the purpose of making a comparison of the meteorological effects upon pupils of different ages, and especially upon the two sexes at the period of adolescence. Inability to procure the data desired without an immense amount of time devoted to a study of the records makes it impossible to include such a comparison in the present paper.

By the term "registration" is meant *expected attendance*. The school registers placed at my disposal through the kindness of Superintendent Jasper, of the New

York public schools, show what is termed the "Permanent Register" and also the "Temporary Register." In the former are included the names of all the pupils who have been registered in a given grade for the entire term. In the latter are included only the names of those who are for the day in regular standing in the grade, and expected to be present. The latter were taken as representing this class of data. The figures given indicate the number of pupils who were registered for a single day's attendance in the grades studied. I shall call, in succeeding discussions, the school attendance of a single pupil for a single day, one *pupil-day.*

II. Attendance in the same schools for the years 1895-96, 108,020.

The data were obtained from the records already referred to, and the number indicates the number of pupil-days recorded for the exact conditions studied under registration.

III. Deportment in the same schools for the years 1895-96, 14,083. Under this head are tabulated for the years studied the number of pupil-days on which marks for imperfect deportments were given. The pupils are marked, when any record for deportment is kept, on a scale of ten, and any mark below ten is considered imperfect. It might at first seem that there would be some value in considering the various marks between ten and the lowest given, as indicating misdemeanors more or less grave; but upon noting certain individual peculiarities in the marking, it was decided that no sufficiently exact criterion could be had, and all not perfect were bunched as imperfect. For instance, some teachers never gave a mark lower than nine, while others invariably indicated imperfect deportment by marks from five to eight. As it cannot readily be supposed that all the pupils under the second teacher were so much worse than any under the first, we must conclude that the differences were in the method of marking, hence an introduction of error if used for exact purposes of comparison.

It might be added, in connection with our statements of data having to do with the New York public schools, that much time was spent in an ineffectual attempt to find records indicating the daily marking in the schools as showing the perfection of class work. No such records are required in the public schools of the city, and in a long series of inquiries not a single teacher was found who had imposed upon herself the task of keeping them. This necessitates the omission from this study of an interesting phase of the problem, which I hope some time to supply from the records of some of the older private institutions, which a diligent search may unearth. The data under classes XV. and XVI. have to do with the effect of meteorological conditions upon the ability to do mental work, and may in part take the place of the class here missing.

IV. Deportment in the public schools of Denver, Colo., for the years 1882-96.

In the study of the public schools of Denver, Colo., made one year previous to the studies in New York City, the records for the fourteen years from 1882 to 1896 were made use of.

No record of daily deportment was kept for any part of that time, the only thing throwing any light upon the question being a record of corporal punishments administered. This record was in the form of notes written in compliance with a requirement of the school board to Superintendent Gove, stating the names of the pupils to whom corporal punishment had been administered, and for what. Only those notes were used as data which stated the exact date of the misdemeanor, and not that of the punishment—the important thing from our point of view—and many notes had to be discarded because of uncertainty on that point. No attempt was made at any classification of the misdemeanors recorded—so varied were they in their character—nor was the tabulation for the two sexes kept separate.

V. "Assault and battery" for the City of New York for the years 1891-97: Male, 36,627; female, 3,134.

These figures represent the total number of arrests for this crime for those years. They were taken from the records in the wonderfully complete archives of the Police Department of the city. The records for the two sexes were considered separately for purposes of comparison.

VI. Murders for the city of Denver, Colo., for the years 1884-96, 184.

These data were taken from the files of the daily papers of the city. A record of assaults, such as is made use of in the study for New York City, would have given us many more data of a class indicative of an emotional state analogous, perhaps, to the homicidal; but it seemed probable that the newspaper record was not complete for this class of crimes, so the record of murder was taken as being trustworthy and exact.

VII. Discipline in the New York City Penitentiary for the years 1891-97, 3,981.

The record of dark-room punishments was made use of, it being the only record of deportment permanently kept at this institution. Each convict's chance for commutation of sentence depends upon the freedom of his record from bad marks, and by looking over each individual's record the data were collected. Care was also taken to make certain that the misdemeanor occurred upon the same day as the recorded punishment.

VIII. Arrests for insanity for the City of New York for the years 1891-97: Male 2,467; female, 1,097. These data were taken from the records at the Central Police Station, and represent the entire number of each sex who were arrested upon the streets by the police of the city, or were taken from their homes, mentally unbalanced. In most cases they were initial attacks of insanity, or, at any rate, the beginning of a recurrent period.

I have visited most of the asylums in the vicinity of New York City in the hope that I might secure some record of discipline or restraint throwing light upon the daily deportment of the inmates, but as yet unsuccessfully. It may be that some future search will be productive of more results, and that this phase of the problem may be completed.

IX. Persons receiving treatment in the out-patient department of the Roosevelt Hospital, New York City, for the years 1893 and 1894, 75,486.

This study was undertaken with the hope of throwing some light upon the question of the influence of meteorological conditions upon health.

X. Members of the New York police force who were off duty, supposedly for sickness, for the years 1891 to 1895, inclusive; single day's absence, 191,137.

The general aim of this study was the same as the last.

XI. Deaths for the city of New York for the years 1886-87, 74,793.

This includes deaths from all causes. The data were taken from the books of the Department of Public Health. The years 1886-87 were used, not that they were any more interesting than other years, but because they were the last for which records were kept in such a way that the exact date of death could be determined without some doubt. Beginning with 1888, the record of issuance of burial permits was the only one kept, and as these were sometimes issued on the day of death, but just as frequently on some following day, these latter records would not have been sufficiently exact for our purpose.

XII. Suicides for the city of New York for the years 1882-87, 2,946.

These data were collected from two sources, viz., the records of the Coroner and those of the Police Department. The record of successful suicides came from the former source, and are included in the death records; but since for our purposes an unsuccessful attempt was as valid a datum as the successful, indicating, as it does, suicidal intent, they were included in this study. The police record was the source of our information on this subject, since suicide is considered a felony.

XIII. Suicides for the city of Denver, Colorado, for the years 1884-97, 260.

These data were taken from the voluminous scrapbooks of newspaper clippings kept by the chief of the detective force of Denver. The city keeps no official register of crime, but the officer mentioned has kept a most complete one, clipped from the columns of the daily papers, which, through his kindness, was placed at my disposal. The data include both suicides and unsuccessful attempts.

XIV. Arrests for drunkenness for the city of New York for the years 1893-94-95; males, 44,495.

XV. Clerical errors discovered in the records of certain of the national banks of the city of New York for the years 1896-97, 3,698.

These data were taken from books known as "Correction of Errors," kindly loaned by some of the largest national banks in the city, among them, in fact, the largest bank in the country. These books show the data and the magnitude of all errors made by the employees of the bank, together with the date of their discovery and correction. The date of occurrence was, of course, the important item for our study.

XVI. A study in discrimination carried on in the Psychological Laboratory of Columbia University, 50.

Since all the conclusions to follow are based upon what I have called "expectancy," and an interpretation of the tables presupposes a full understanding of this term, I shall now, at some length, explain its computation and application.

The first process in its construction was carried on at the New York office of the U. S. Weather Bureau (Denver office for the Denver study). There, in a specially-ruled blank-book, were copied the mean *Barometer, Temperature, and Humidity, the Total Movement of the Wind, the character of the Day, and Precipitation* for every day of all the years for which any of the data of the studies were collected. For New York these years were 1886-87 and 1891-97, inclusive, besides the limited periods in the years 1898 and 1899 made use of in studying the class of data designated as XVI.

For Denver, the years so studied were those from 1883 to 1896, inclusive. Separate "expectancy curves" were constructed, by the method I am about to explain, for the period 1886-87, the period 1891-97, the school months of the calendar year 1895-96, and for Denver.

Since these curves were all constructed in the same manner, a description of the process for one will answer for all the others, so I will explain those only for the 1891-97 period.

First. The expectancy curve for temperature.

By a process of tabulation, which was practically but a simplified method of counting, it was ascertained that of the 2,557 days of the seven years considered, 2 had been recorded as having a mean temperature between 0° and 5° Fahr.; 3 between 5° and 10°; 21 between 10° and 15°; 28 between 15° and 20°; 80 between 20° and 25°; 124 between 25° and 30°; 203 between 30° and 35°; and so on, until all the 2,557 days were thus accounted for, in some one of the groups of 5° temperature between zero, the lower limit, and 95°, the upper limit.

It would have been possible in a similar manner to count the number of days for each single degree; but a curve based upon such a complicated series would be almost unintelligible; so definite meteorological groups have been chosen for each condition, as being better for our purpose than the single unit of measure.

Having thus counted the number of days occurring in each one of the temperature groups of 5°, the next process is to turn these numbers into percentages of the whole number of days, and we find that one-tenth per cent. (.1%) of the days for the seven years had a mean temperature between 0° and 5°; .2% between 5° and 10°; .8% between 10° and 15°; 1.19% between 15° and 20°; 3.1% between 20° and 25°; 5.5% between 25° and 30°; and so on. These figures represent the normal prevalence of the temperatures represented by each of the groups.

It can be readily seen that this represents the percentage of data of any class which the law of numerical probability would lead one to expect under that condition, *if the temperature exerted no influence.* For instance, if 5.5% of the days for the seven years had a mean temperature somewhere between 25° and 30°, the law of probability would lead us to expect that same percentage (5.5) of the entire number of murders or suicides or deaths occurring in that period to have occurred under that temperature group, *provided the temperature itself had no effect.*

To illustrate: One-seventh (1-7) of all the days of the year are Mondays, 1-7 Tuesdays, 1-7 Wednesdays, and so on through the week. Now since one-seventh equals 14.3%, 14.3% of the days of a year, or any number of years, are Mondays, 14.3% Tuesdays, and the same for the other five days. Since this is so, the law of numerical probability would lead us to expect that same per cent. (14.3) of all the murders or suicides or deaths for a series of years to occur on each of the days of the week, provided there was no condition, social or industrial, to affect their distribution. Whatever variation might be found to exist must be ascribed to some force affecting the conditions.

For the barometer, one-tenth (1-10) in. variation in the heights of the mercury column was taken as a unit of difference; for humidity, five-hundredths (5-100); and for wind, a difference of 50 miles in the total movement for the day.

As has been stated, a special "expectancy curve" was made use of for the year 1886-87, and for the school years. The necessity for so doing was this: Although the "expectancy curve" for the seven years from 1891-97, inclusive, may be considered a normal curve for all time, it could hardly be referred with exactness to isolated years without the introduction of considerable error, due to the variation of those years from the true normal, hence the necessity of extra labor in the preparation of a special curve for those years.

A separate curve for the school year is even more necessary, since so large a portion of the calendar year, and that at one of the extremes of temperature, is left out. Neither of these special expectancy curves is shown upon the tables or charts, though they have been made use of in plotting all the curves indicating conditions for death, suicide and the school problem.

Having explained the construction of the "expectancy curve," it now remains to show its application. Opposite the meteorological conditions for each day, as they were copied in the blank-book already referred to, were placed, in separate columns, the number of data of each class for that day,—that is, one column for each of the classes of data relating to the public schools, one each for male and female assaults, one for discipline in the penitentiary, one each for male and female insane, and so on for all the classes studied.

Since all were treated alike in constructing what I have called the "occurrence curve," that for male assault only, in its relation to the expectancy curve for temperature already discussed, will be considered. The sum of the data for this class of assaults for the 2,557 days of the years 1891-97 inclusive, was 36,627. By the process of tabulation made use of in constructing the expectancy curve, it was found that 50 of that number occurred on days when the temperature was between 0° and 5° Fahrenheit; 53 between 10° and 15°; 288 between 15° and 20°; and so on for each group of 5 degrees up to the upper limit of daily mean. Turning these numbers into percentages of the whole, as was done in the previous discussion, we have .1% for the temperature group 0° to 5°; .1% between 5° and 10°; .7% between 10° and 15°; .8% between 15° and 20°; and so on. The curve itself is not shown upon any of the tables. Now, we have already computed and shown in the "expectancy curve" the percentages which the law of numerical probability, applied to each of the temperature groups, would lead one to expect. A comparison of these percentages of occurrence with those of expectancy would indicate whether there was an excess or a deficiency for any of the groups. In the case under consideration, for the temperature group 5° to 10°, the expectancy was .2% and occurrence .1%. But .1% is but one-half of .2%, *or* 50% of .2%, *or* 50% less than .2%, and we have its relation to the expectancy indicated as —50%. This fact is shown on the proper figure by the curve being 50% below the heavy line. For the group 10° to 15°, the expectancy is .8%, and the occurrence .7%. But 7 is 1, or 1-8 of 8, less than 8, or 12.5% (=1-8)) of 8 less than

8, which fact is indicated upon the chart. For the next group the expectancy is 1.1%, and the occurrence .8%. By the same computation it will be seen that .8% is .27% of 1.1% less than 1.1%, which is also indicated.

This is the method of computation made use of in all the curves except the "attendance" curves (Figs. 4 to 9), and those for data classed as XVI.

In brief, *when a curve is above the heavy horizontal line it indicates an excess of data to an amount represented by its distance above the horizontal or datum line; when below, a deficiency of the magnitude indicated by its distance below.* In some of these figures, ordinates are used, the curve being represented by the upper extremities of the ordinates. In these figures, 100 per cent. or expectancy, is represented by the ordinate distance from the *base line* to the horizontal datum line above. Although the curves show with exactness the relation between the *expected* number of occurrences and the actual number for any group of meteorological conditions, there are some few facts which might well be borne in mind in regard to them:

First. They mean more and perhaps are more valid near the center of the curve than at the extremes, for the reason that near the center they are based upon more data and are, therefore, less liable to be affected by conditions accidental to the problem.

Second. Each meteorological condition has to be studied and the curves constructed as if none of the other conditions were in any way effective.

Unless two or more of the conditions tended to vary in the same way, this fact would have no effect upon the curves, as otherwise, in the great number of days studied, the influence of one upon another would tend to negative the effect. If, however, two conditions generally accompany one another, there would be a possibility that effects indicated by the curve of one condition were contributed to by the other, without that fact being in any way shown.

Third. The excesses and deficiencies indicated by any curve need not be, and probably never are, equal. Although the sum of all the percentages of the Normal Prevalence Curves, and also the Occurrence Curves (not shown), upon which the curves for each class of data are based, is 100, it is not so for the curves plotted, because the latter are based upon many more data in some parts than in others. To give a concrete example: In a certain meteorological group 1% of all the data considered might be "expected" and 2% occur,—that is, 1% more, or twice as many,—but the plotted curve would show 100% excess. In another meteorological condition 10% of all the data might be expected and 9% occur (the same actual number less), while the plotted curve would indicate a deficiency of but 10%. From this illustration it may be seen that there can be no constant relation between the indicated excesses and deficiencies of any curve.

Fourth. By making use of meteorological groups rather than smaller units of measure for each condition, some of the real effects of those conditions may not be indicated by the curves. It would, however, be utterly impracticable to work out the expectancy and occurrence for each degree of temperature or for each hundredth of an inch of the barometer, and I am inclined to think that the loss for grouping is very slight. Certainly there is no positive error introduced by so doing.

CHAPTER VI

THE METEOROLOGICAL CONDITIONS

Since we have considered the effects of weather as but the resultant of the combined effects of its ever-varying components, it is necessary that those components be defined and a description given of the process of their measurement, as carried on by the United States Weather Bureau. Incidentally, too, we mention the recognized influence of each meteorological condition upon climate, in its effect upon racial traits.

Temperature. Man surpasses all his fellows in the animal kingdom in his ability to live in different degrees of temperature, the extreme range of the thermometer for all parts of his habitat being nearly 200 degrees Fahrenheit. It is even probable that a single individual might experience both of these extremes for a brief period without disastrous results. In their effects upon the race, however, varying temperatures have been recognized by every student of climatology. Inhabitants of hot climates are usually listless, uninventive, apathetic and improvident. An equable high temperature, especially if moist, weakens body and mind. No long-established lowland tropical people is a conquering race in the broadest sense of the word. For the inhabitants of the higher altitudes, even under the tropical sun, this may not be true; for as we ascend, the temperature lessens about one degree every 270 feet on an average, and even at the equator we may have a temperate climate.

The most favorable temperature for health that carries with it an aggressive energy which is felt, and which has led the world-march of civilization, is about 55 degrees to 70 degrees, on an average; and this is found in the temperate zones. From there have come the brawn and brain of martial conquest and intellectual attainment. The dominant peoples are shown between the latitudes of 25 degrees and 55 degrees. Farther north the available vital energy seems so largely expended in furnishing mere body heat and stimulus for the necessary physiological functions, that there is little left for use in those activities which make leaders.

The question as to the ability of races to thrive under conditions of temperature other than those of their ancestors is one which has received considerable attention. It has long been held that the tropics could never become a field of conquest for the nations of the temperate zones, since the climate rendered occupation by them impossible. Notwithstanding the fact that distinguished observers maintain this, experience seems to demonstrate that acclimatization depends very largely upon a rigid observance of sanitary and hygienic rules, and many places which were once considered fatal to the white man are being proved comparatively healthful. When we consider that they have lost their bad name solely by an exercise of local and personal hygiene, we must not despair of the power of man to reduce the unhealthfulness of even large areas in tropical climates.

The apparatus used by the Weather Bureau at its various stations for measuring the exact temperature are the thermograph and the maximum and minimum thermometers. The former gives a continuous record of the temperature; the latter two show respectively the highest and the lowest temperature for each twenty-four hours. The temperature readings made use of in this study (except for problem in discrimination) are the average of all observations for each day. This is found to be practically the average of all the temperatures for that time—that is, of the termograph readings.

Barometer. At the sea-level, or near it, the mean barometer readings for the year are practically the same the world over. Any study then, of the effects of climate as indicated by prevailing barometric conditions must be largely one of altitude. At the level of the sea the weight of the atmosphere above is equal to the weight of a column of mercury 76mm., or 29.98 inches high, this being the normal height of the barometer at that level. As we go to higher altitudes, we climb through some of the atmosphere, leaving it at levels below us. This fact is shown by lessening of the height of the mercury column as compared with lower barometric readings. For the lower regions of the atmosphere (three miles or so) the mercury column falls about one inch for each 1,000 feet of ascent. The variations of the barometer at a given location are due to atmospheric conditions, such as moisture or an upward or downward direction of wind columns. We are not, however, in this chapter, concerned with such variations.

The general effect of high altitudes is undoubtedly an invigorating one, though liable to affect disastrously the action of the heart and the nervous mechanism. The ability of a healthy man suddenly to transplant himself to altitudes at which the pressure of the atmosphere is reduced one-third or even more, without effect, seems wonderful. I have myself spent some weeks in succession at an altitude of over two miles, and on several occasions spent the night upon the summit of Pike's Peak (14,147 feet) without noticing any effect other than a slight quickening of pulse and respiration. Prolonged residence, however, at any altitude above one mile seems, at least in Colorado, to prove cumulative in its effect upon the nervous system, inducing in most cases a neurotic condition that is relieved only by a temporary residence in a lower altitude. These facts will be alluded to in a discussion of the Denver curves.

Dr. Marcet says:[1] "The effect of altitude and cold combined is to increase the amount of carbon dioxide expired. Less air is expired at high altitudes. It appears that the blood more readily acquires oxygen there than at low levels."

Increased expansion of the chest and action of the heart add to the strength and vigor, and mountain races are generally fine in build. If, too, we are to judge by the histories of the Swiss people, and of the Spartans, or even the mountain Indian tribes of our own country, compared with those of the plains, we must concede that boldness in the face of danger and a love of liberty are in some way closely associated with life in the higher altitudes.

For studying the pressure of the atmosphere, the stations of the Weather Bureau are equipped with self-

[1]Proceedings of the Royal Society.

registering aneroid baragraphs and mercurial barometers. Readings from both are corrected for the altitudes of the station, and for variations in temperature. The barometric data used in this study are the *means* for all observations for each day.

Humidity. Great humidities are preëminently characteristic of the climates of certain localities, and very low ones of others, and the effects of the two conditions upon the inhabitants have been the subject of considerable study. The greater part of it has aimed, however, to discover their effect upon various prevailing diseases, though not without bringing out incidentally the general influence upon race type. From the standpoint of health, dry air is almost universally favorable to human life. This may be due partly to the fact that the germs of contagious diseases do not there find the culture-media for propagation which the moist surfaces of rocks and foliage in a humid atmosphere present, although there is undoubtedly a direct organic effect as well. Excessive heat, together with great humidity, forms a most deadly combination for one not acclimated to it, as the mortality on the west coast of Africa testifies; while in some localities—as, for instance, western Ireland, the lake regions of England, and the extreme northwestern coast of our own country—much moisture from a great rainfall without excessive heat is not particularly unhealthful. In its effect upon the emotional and intellectual characteristics of a race, it is hard to consider humidity apart from the other weather conditions which accompany it.

A region of great humidity must be one of much rainfall, fog, and many cloudy days; while one of low humidity, in all probability lacks these as prevailing conditions. As they are all considered under other headings of this section, and humidity has incidentally been touched upon in the previous topic, we shall not attempt it here.

The determination of humidity, or relative humidity, as it is called by the Weather Bureau, is accomplished by means of two thermometers, the so-called dry-bulb and the wet-bulb.

The first is the ordinary thermometer, by which the temperature is indicated. The second is similar, except that the mercury bulb is surrounded by a cloth which may be saturated with water. When this is done, air is artificially made to pass over the saturated cloth, which causes the water to evaporate rapidly. The heat which is rendered latent by this process comes from the mercury of the thermometer, making it descend in the tube with a rapidity proportional to that of evaporation. In dry air the latter process is much more rapid than in damp air, and by noting the difference of the readings of the dry-bulb and the wet-bulb instruments, and making a simple mathematical computation, the relative humidity is determined. It is read in hundredths, one hundred meaning air saturated with moisture, and zero, air free from it. The former point is often reached; the latter never. The humidity made use of in this study is the *mean* of a morning and an afternoon observation.

Wind. As an element in climate, the effects of the wind are harder to determine than those of other meteorological conditions. Not that its effects are not great; but that they are occasional and might perhaps more strictly be regarded as an element of weather than of climate. A study of the chapters that compare the wind effects at Denver with those at New York will convince one that they certainly are not in any way proportional to the velocity of the wind; but with the prevalence of other meteorological conditions, together with the wind, each, seemingly, strengthens the effect of the other. The direct physiological effects of winds of different humidities have been noticed.

Dr. Arthur Mitchell,[1] in a report read before the Meteorological Conferences, speaks of the effects of the east wind prevailing on the coast of England:

"Such winds, blowing over a moist surface, such, for instance, as that of the human body, tend to reduce the temperature of that surface to the temperature of evaporation, which is much below that of the air itself. In licking up the moisture—that is, causing its evaporation—a large amount of heat is rendered latent. This heat must be taken from something, and, in point of fact, our bodies are, and must be, almost its entire source. A cold and dry wind, therefore, cools the surface of our bodies, not only by enveloping them in a cool medium and warming itself by conduction at their expense—it does that, of course—but, being dry as well as cold, it does it with less activity than though it were moist and cold, damp air being a better conductor than dry air. It is chiefly, however, by the other mode that dry, cold winds abstract heat from our bodies—that is, by using their heat in the conversion of moisture into vapor. The heat so used becomes latent, and is, for the time being, lost. It does not raise the temperature of the air in immediate

[1] *Nature*, Vol. 30, p. 355.

contact with our bodies. The quantity of heat which our bodies lose is probably far from insignificant, and the loss cannot be sustained without involving extensive and important physiological actions, and without influencing the state of health. In feeble and delicate constitutions the resources of nature prove insufficient to meet the demands made upon them, and a condition of disease ensues. It does not seem improbable that prevailing winds of such characters might be considered as elements in climate, which might in course of time produce even racial changes. Certainly the nurture of disease, especially if the disease prove to any extent mortal, would, in accordance with the laws of heredity, tend toward the introduction of physiological tendencies, which might even have their mental concomitants."

Of occasional winds, some, such as the siroccos of northern Africa, are so baneful as also, it seems, to leave permanent results upon the characteristics of the people. In *The Living Age*[1] there is a description of the peculiar effects of winds sometimes prevalent at Buenos Ayres, South America. Sir Woodbine Parish, upon whose book the extract is based, says:

"To the north of the city lies a very marshy district, while to the southwest lies the great chain of the Andes, separated only by the dry plains of the Pampas, and according as the wind blows from one or the other of these directions the effects are very remarkable. By the time the north wind has reached the city it has become so overcharged with moisture that everything becomes instantly damp. The effects produced in the human body are a general lassitude and relaxation, opening the

[1]Vol. 17, p. 1118.

pores of the skin and inducing great liability to colds, sore throat and all consequences of checked perspiration. This damp wind of La Plata seems to affect the temper and disposition of the inhabitants. The irritability and ill humor it excites in them amount to little less than a temporary derangement of their moral faculties. It is a common thing for men among the better class to shut themselves up in their houses during its continuance, and lay aside all business till it has passed; while among the lower classes it is always remarked that cases of quarreling and bloodshed are more frequent during the north wind than at any other time. Even murderers are said to lay to it the blame of their foul deeds. No sooner, however, does the southwest wind, blowing from the dry and snowy summits of the Andes, set in, than health and comfort and peace are restored."

Disastrous to good conduct as these winds seem to be, they are hardly worse than some exactly their opposite—both in temperature and moisture—which are occasional visitors to the higher altitudes of Colorado. During the prevalence of such, the humidity is invariably excessively low, and in the dry air there seems to be set up, by the movement of the wind particles and the leaves and grasses set in motion by them, an electrical state which in some undetermined way wreaks havoc with the emotions. Its effect is, however, shown empirically by some of the curves.

The Signal Service makes use of two instruments in studying the wind,—a vane with automatic electrical indicator for showing its direction, and the anemometer for registering the velocity. Both of these are exposed to the unobstructed force of the wind, though connected electrically with the indicators in the office below. Both the instruments register upon a drum revolved by clock-work, and at any time the direction and velocity of the wind can be seen at a glance. The total movement for the day, or the number of miles blown for twenty-four hours, is used in all our studies except XVI.

Character of the Day. This condition has no relation to rain or snow-fall; nor is fog indicated directly by any of its conditions. The terms "Fair," "Partly Cloudy" and "Cloudy," refer only to the periods of sunshine for each day compared with the whole time from sunrise to sunset. If for eight-tenths or more of the latter period the sun is obscured, the day is characterized as "Cloudy;" if four-, six- or seven-tenths are obscured, as "Partly Cloudy;" if less, "Fair."

Many opinions have been expressed, both in general literature and in purely scientific writings, as to the racial influence of these characteristics of climate. Italy has always been "Sunny Italy," and England "Gloomy Britain," and the supposed effects of the two conditions made the excuse for many different traits of character. Dickens based many of his tragic climaxes upon his analysis of their influences, and many other writers have made stock of them. Yet, after all, characterization of any race must be based upon definite acts of individual members of that race; and a comparison of races and racial traits should be made only through a comparison of the conduct of their respective peoples. In such an inductive study we fail to corroborate the mass of existing opinion with respect to the effects of a "sunny clime," or its opposite. It has been stated that "the excessive number of suicides for England is due to its gloomy climate" (Montesquieu); but data show that the number per 100,000 for England is less than that for any other European country. Vilemais maintains that "nine-tenths of the suicides occur in rainy or cloudy weather." For data in refutation of that statement, in New York City at least, for the period considered, I refer to the curve for suicides in New York, shown upon Fig. 43.

Another interesting fact bearing upon this point is shown on the same chart by the Denver suicide curve; and although the percentage of fair days is three times greater than in New York City, the number of suicides runs up as much for cloudy days as in the latter climate it runs down.

Even at the risk of robbing the section in which suicides are especially discussed, I shall here insert a quotation from a very interesting paper that appeared in *Once a Week* (Vol. 19) without signature (the writer was evidently not a Scotchman):

"The idea that the prevalence of suicide in this country is due to our bad weather is precisely one of those hasty and illogical inferences whch are characteristic of the Gallic mind. The constant gloom of bad weather ought to acquaint us so thoroughly with moods of depression that suicide would never occur to us. Look at Scotland, for instance, where suicides are rare. Why are they rare? Simply because a succession of Scotch Sundays has so accustomed the people to prolonged despondency that any sudden misfortune cannot sink their spirits any further. One has only to spend a dozen Sundays in Glasgow or Edinburgh to become inoculated against suicide. So far from November fogs driving people to jump off Waterloo Bridge, they ought to train and educate the mind to bear any calamity. A man who has taught himself to eat prodigious quantities of opium feels scarcely any effect from other forms of intoxication. We can educate our mental susceptibilities as we can our muscles, and the more we educate them the more they will bear."

There are many truths beneath the jocular vein of this quotation, and the writer expressed more fact than perhaps he knew. A constant succession of gloomy days is certainly not conducive to emotional flights; but the sturdy determination and evenness of temperament of the English have without doubt been contributed to by them. The almost constantly sunny climate of Colorado has, I believe, even in the few years it has been enjoyed by the white man, tended to produce a state of emotional inequilibrium which has shown itself in many ways, and has had its effects upon the political and social history of the region.

The apparatus used by the Weather Bureau for determining the character of the day is known as "sunshine recorder." It consists of a thermometer, with its bulb blackened to increase the absorption of heat from direct sunlight, enclosed in a vacuum tube to prevent as far as possible the direct influence of the temperature of the surrounding air. The piece of apparatus is in such a position as to receive the sun's rays during the entire day. When the direct rays strike the blackened bulb the mercury suddenly rises and closes an electrical circuit, which causes a record to be made upon a revolving drum in the office below. When the sun is obscured the mercury drops and the circuit is broken. The computation in tenths of the possible sunshine hours is made by the weather official.

Precipitation. There is little to be said upon this condition of climate, in its effect upon race characteristics, which has not been touched upon under the preceding topic. By it is meant a fall of water in some of its physical states.

Regions where precipitation is great are generally less healthful than where the amount is less; though some exceptions to this have already been cited. Attention might here be called to the fact that the relation between cloudy days and those showing precipitation is not so constant as might at first seem probable. That is, a day on which a shower took place, even though the rainfall was considerable, would be classed among the fair days, provided the whole period of cloudiness was less than three-tenths of the period from sunrise to sunset. Since, however, there are no climates where days of such a character form a constant element, they need not here be taken into consideration. Undoubtedly thunderstorms induce in many persons emotional states which seem to be productive of excesses in deportment; but we must remember that these excesses are caused by the electrical conditions or by a superstitious fear which cannot be controlled, and we should not attribute them to the precipitation. These are, however, elements of weather, rather than of climate in its broadest sense.

The latest device used by the Weather Bureau for measuring the precipitation consists of a hopper or scale-pan which is so constructed as to tip and empty itself, and at the same time make an electrical indication of the fact in the office below, for each one-hundredth of an inch of precipitation. By counting these records upon the revolving drum, the officers can tell the exact time, the rapidity, and the amount of precipitation for each shower or period of rain.

In our study, a day is considered as having precipitation if the hopper of the instrument has emptied itself once. No consideration is taken of the amount beyond this.

Fig. 1 shows the monthly *means,* both for New York City and Denver, Colorado, of the meteorological condition discussed in this chapter.

As will be seen, the two curves for temperature run very nearly parallel, the only marked difference being that the heated season for Denver extends a little later into the autumn, giving October a temperature a few degrees warmer than for the eastern city.

It will also be noted that the western mean for the hottest months is a little below the other. This fact is undoubtedly due to the cooler nights, the temperature of which is included.

The barometer curves are of not much value for our present study, because of the difference in altitude. The Denver curve must be read exactly five (5) inches below its position on the chart, and other than this indicated difference in pressure, perhaps little can be deduced from it. The curves for humidity are, however, of interest. The differences in atmospheric moisture shown by them are well recognized elements of contrast in the two climates. The noticeable fact is prevailing low humidity (dryness) for Denver, compared with the sea level, with the highest mean for the year (January) ten one-hundredths below the lowest, (April) for New York.

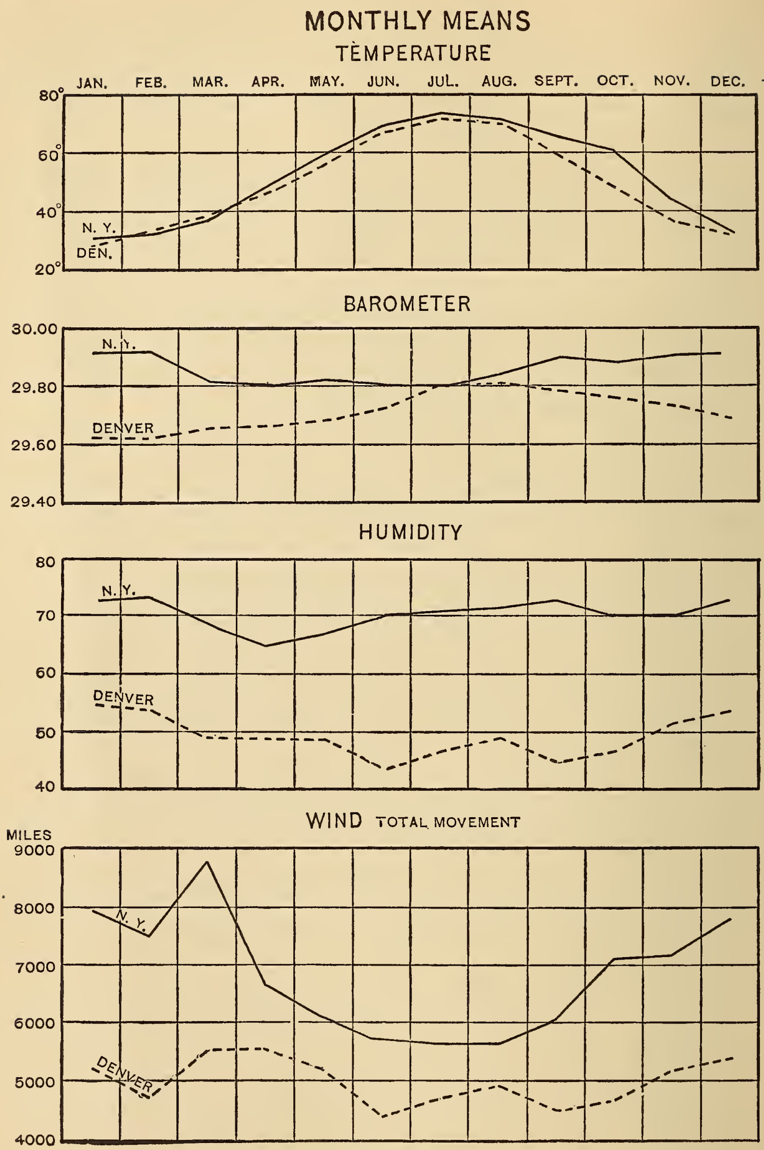
MONTHLY MEANS
TEMPERATURE
JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEPT. OCT. NOV. DEC.
80°
60°
40°
20°
N. Y.
DEN.
BAROMETER
30.00
29.80
29.60
29.40
N. Y.
DENVER
HUMIDITY
80
70
60
50
40
N. Y.
DENVER
WIND TOTAL MOVEMENT
MILES
9000
8000
7000
6000
5000
4000
N. Y.
DENVER

Figure 1

This fact is, however, discussed in connection with other curves later in this volume.

The *means* for the total movement of the wind (anemometer registration for the month) furnish, I believe, a veritable surprise for the Coloradoan. If there is any vulnerable point in his climate he has always supposed it to be the wind. "These horrible winds," and "the windiest place I ever knew" have been common expressions of the newcomer, and the old resident has hardly dared to contradict them. Here, however, we have irrefutable evidence to the contrary, for these figures were taken from the Weather Bureau's records for twenty-one (21) years. Yet the highest movements for Denver (March and April) are less than the lowest for New York (July and August), and the average for the year 2,000 miles per month less. The eastern March, with its 8,800 miles, fairly puts to shame its western contemporary, and the patriotic Denverite can add one more arrow—perhaps an unexpected one—to his quiver. It is true that the anemometer at the New York station stands about seventy-five feet higher from the ground than the one at Denver, but this difference can hardly account for the difference in registration.

Yet it must be conceded that in one respect the western wind is more disastrous than that of the east. The studies referred to prove conclusively that its mental effects are greater. During high winds the prevalence of suicide and of murder, also of misdemeanors in the public schools, ran up to six or eight times the normal; while for the east the increase in all but suicide was found to be slight for such conditions. This was hypothetically accounted for by reference to the high electric potential of the atmosphere at such times.

The precipitation for New York City is about three and one-half times that for Denver.

The latter city has 42 per cent. of clear days to 27 per cent. for New York. The partly cloudy days are about equal, while the eastern city has about double the number of cloudy days. About this same relation exists too for days upon which precipitation was registered (Denver 16%, New York 37%).

CHAPTER VII

THE CHILD AND THE WEATHER

The phase of the weather problem discussed in this chapter was, at the beginning of the work, the only one anticipated. The whole study was undertaken from the standpoint of the teacher, with the hope of answering some of the puzzling questions which arise within his mind as to the seeming effects of these conditions of the cosmical environment upon the pupil. As the work proceeded, it broadened more and more, taking in other classes of data cognate to the subject, until those mentioned in the last section were considered, with the field scarcely entered. The study has become a fascinating one, and though sanguine of the validity—as far as inductive studies may be valid—of certain of the conclusions, it might be well to state what seem to be the exact scope and bearing of the problem.

First. It does not seem probable that we are dealing with the *immediate cause* of any of the occurrences studied. In the case of those considered in the present section, we are not supposing that a low condition of barometer and a low humidity were the direct causes of misdemeanor, but that under such conditions an impulse to be refractory, whatever the immediate cause of the impulse may be, could not be so well withstood as under certain other conditions. In other words, the meteorological conditions are the essential causes of certain general physiological or mental states, some of which seem to be fertile fields for the action of immediate causes which are, from the standpoint of this problem, accidental. To be concrete: on a certain morning, Johnny could not have what he wanted for breakfast, and went to school in a sulk, with a consequent disastrous effect upon his deportment. Most certainly the disappointment at home had a causal relation to his demerit, and no excuse from the weather is sought. But if we take the record of 200 Johnnies for 600 different days, and find that on certain days more of them are out of sorts than on other days, we look for a constant condition which might be considered in some way the cause. We cannot suppose that bad breakfasts, or whippings at home, or the disappointments common to child life would bear this constant relation; we look for it elsewhere. Wherever found, it must be considered valid. But it must be some factor which would be a part of the environment of all the children similarly affected. We have sought for it in the varying conditions of weather, with what success is shown by the curves which form the basis of our discussion. Remember, then, that when we say that high temperatures *cause* an excess of suicides or any of the other occurrences studied, we mean it only in this secondary sense. This explanation must serve as an answer to many of the hypothetical explanations of conduct which were made in answer to the questions we are about to discuss; in fact, it would apply to all the abnormal states which were accidental to individuals, whatever their character or immediate cause.

Second. Although the study discussed in the present chapter is based upon the deportment of children as judged by the teacher, it is not at all certain that the emotional state of the teacher is not an important factor in the result. Indeed, it may be the teacher that we are studying more largely even than the pupil. This has been suggested in many of the notes I have received, and supplementary to the empirical problem with the school children as it has been already outlined, I attempted to secure by means of a questionaire the opinions of a large number of teachers as to the observed influences of the weather upon the conduct and efficiency of their pupils, and shall first describe this phase of the problem.

Third. The effects upon different individuals cannot be supposed to be at all commensurate. There may be many whom weather conditions do not appreciably affect; but in any inductive study we seek general laws, and though they may not be true for any single individual, yet they are valid for them all as a class.

Before entering into a discussion of the questionaire I wish to say that I recognize fully the short-comings of the method. Questions, however carefully framed, are suggestive of certain answers and, no doubt, frequently influence the judgment of those responding, in spite of all precaution. It is probably true, also, that of the whole number of persons appealed to, a larger proportion of those whose opinions are positive—that is, are affirmative—take the trouble to reply, than of those whose opinions are negative, or of those who have no definite opinions at all. I have, however, considered the returns of sufficient weight to merit full discussion.

The questionaire was as follows:

Date..

Name..

Position. ....

About how many individuals are under your direct observation:

Adult Male.................... Female....................

Youth (15-20) " .... " ....

Children " .... " ....

2 Have you noticed any seeming effect of weather conditions on their deportment?

	Hot	Cold	Windy	Calm	Stormy	Muggy	Cloudy	Clear
3 What kinds of days seem to affect them for the worse.......								
4 On what kinds of days do they seem at their best........								
5 On what kinds of days does mental work seem at its best								
6 At its worst..........								
7 If your charges do mechanical work, on what kinds of days can they turn out most............								
8 Least								

Put X in proper space. "Hot" and "Cold" mean for the time of year. "Muggy" means "sticky" or humid.

Extended remarks bearing upon the subject are very much desired, and may be written on the other side of this blank.

If you have noticed a different magnitude of effect upon men, women, boys or girls, please state it.

Many of the remarks by teachers in various parts of the country in response to the request at the bottom of the questionaire are very valuable, and I regret that space does not permit the publication of more of them in full. Of the 200 questionaires sent out, 86 bearing upon the public school problem were returned filled out in full. Several who did not care to answer definitely the questions given, wrote their general observations in a very helpful manner. The exact number of pupils upon whom the answers to the definite questions were based was as follows:

For climates similar to that of New York (Philadelphia, Boston, and the coast cities and towns):

Boys	4801
Girls	3148
Boys doing mechanical work	3300
Girls doing mechanical work	1500

For Colorado:

Boys and Girls	2218

For the latter climate no estimates were given for the production of mechanical work. In most cases the replies were from teachers of single grades, giving their judgment based upon observation of a limited number of pupils, though in some cases city superintendents and principals have sent me their estimates of the weather effects upon larger numbers—in one case (Boston) of 1,700. The exact tabulation of all the returns is shown by the curves upon Fig. 2. I have there indicated the judgments for the Colorado climate separately from those from other localities.

The curves show the percentages of all the children of each class for whom the judgments indicated were given. To prevent a complication of curves, I have separated those showing the conditions for which deportment or work was at its worst from those under which it was at its best. To interpret one of the curves in full: the entire line in the upper left-hand corner of the chart shows the judgment of conditions under which the deportment of the boys was at its best. None expressed the belief that it was so when the weather was hot. The judgments based upon 75 per cent. of the pupils observed were that they were at their best, so far as deportment is concerned, under conditions of cold. One per cent. believed the wind had a salutary effect, 64 per cent. calm, 1 per cent. stormy, none muggy or cloudy, and 96 per cent. clear. All the curves may be interpreted in

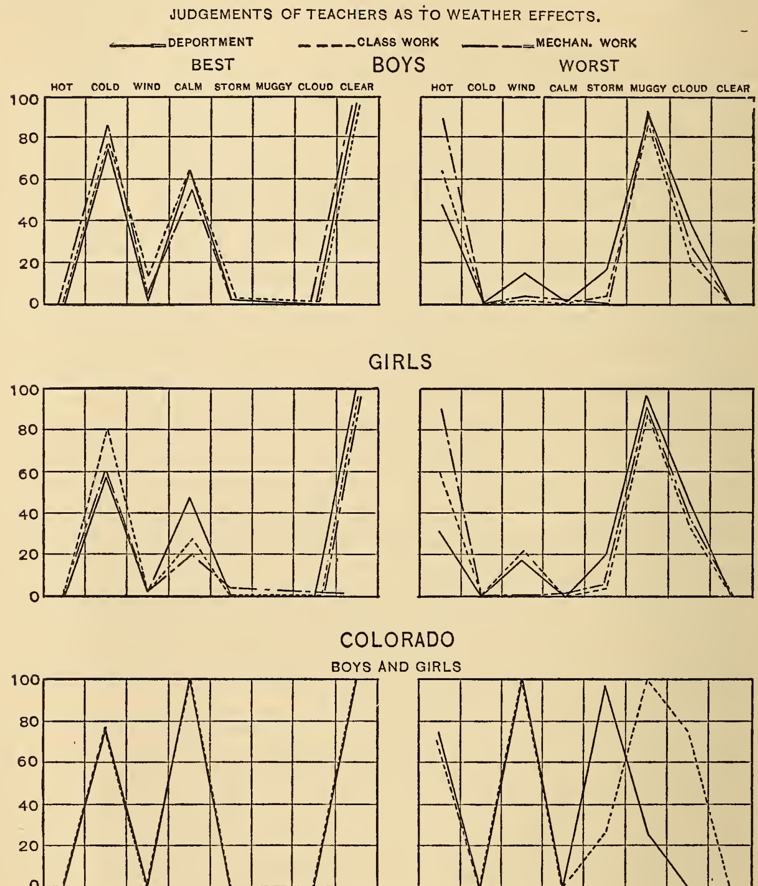

Figure 2

this way, remembering that the curves under the heading "worst" indicate the percentages of pupils upon which judgments for that state were based. The fact that the percentages shown by a single curve foot up to more than 100 indicates that more than one condition was mentioned as being that under which the pupil was at his best or worst. In most cases, three conditions were thus mentioned, though the papers varied in this respect from one to as many as five.

It must, of course, be recognized that the judgment as to what constitutes a given condition—that is "Windy" or "Muggy," "Hot" or "Cold"—must vary with different individuals; but such conceptions are somewhat constant, and would probably not be the source of any considerable error.

Considering first the curves for climates similar to that of New York, we see that cold, calm, and clear days are those on which deportment and work are generally considered to be at their best, with the greatest unanimity with regard to the latter. For "Worst" condition, muggy days take the lead, with hot and windy ones in second and third places. Comparing the Deportment curves for boys with that for girls, we see an indication of what is referred to in the notes discussed farther on—that is, that boys are influenced more than girls by the weather conditions, at least by heat, cold and wind. Seventy-five per cent. of the latter (girls) were judged to be at their best on cold days and 64 per cent. on calm, to 56 per cent. and 46 per cent. respectively for the former (boys); while under conditions of heat 50 per cent. of the boys were thought to be at their worst to 30 per cent. of the girls. A fact worthy of note is the increased bad effect of heat upon the production of mechanical work, over its effect upon deportment or mental work. This would indicate that the increased metabolism of the processes of life under such conditions

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more largely deplete the reserve for motor output than for mental, and in spite of the irritating effect, emotionally, of the temper, leaves little energy for frolicsomeness.

To summarize in brief these curves: hot, cold, calm, muggy, and clear days seem to be the effective ones; cold calm, and clear ones producing a favorable result, and the others the reverse. Windy, stormy, and cloudy days are not generally mentioned as having much influence.

In discussing the curves for Colorado, we have but to call attention to a fact which corroborates in a very marked way conclusions arrived at later in this chapter, namely, the marked effect of the wind. All the returns state calms as an accompaniment of desirable states in the pupil, and wind of the most disastrous. A muggy day is hardly known to Colorado teachers, so we get no corroborative evidence with regard to the problem of humidity treated later.

As shown by the notes received with the data which has been discussed, I may say that there is a much greater unanimity of belief that the weather has its psychical effects, than of expressed opinion as to what those effects are or the exact meteorological conditions producing them. The influence of the conditions studied upon the teacher is not infrequently mentioned, and I quote a part of one of the letters bearing upon this point: "Make due allowance for my 'personal equation.' It is impossible for me to say how far my experience is subjective. It seems to be more marked in this matter than almost any with whom I have discussed it, and I strongly suspect subjective conditions. My experiences when in good and when in poor physical conditions correspond in kind, but are much more intense in the latter case."

The consensus of opinion, both as indicated by the curves and the personal notes, seems to be that girls are much less affected by weather conditions than boys. In eight of the notes the fact was alluded to, while none expressed the opposite opinion. One teacher, a supervising principal of elementary schools in one of the larger eastern cities, says: "The boys are very markedly more susceptible to weather changes than the girls. This apparent result may be due to the generally greater display of effects by the boy, who is under less disciplinary control than the girl."

And another, "Girls are greater adepts, not only at restraining impulses to do mischief, but also in concealing all evidences of it when it is in progress. This may be due to a greater horror on their part of an open reprimand."

It seems to me probable, however, that the matter of reserve and excess of vital energy enters into this problem. The preponderating anabolic tendency of the female, as opposed to the katabolism of the male, may be at the bottom of it.[1] In spite of this expressed belief of a less effect upon girls than boys, a few of the observations by principals, of the influence of the weather upon the teacher, state an opposite effect upon adults of the two sexes.

To quote from the principal of a large city school: "Men, it is true, are depressed on such days" (gloomy days); "but the average man keeps his nerve under proper restraint, which is something which the average woman, from the peculiar mechanism of her nervous machinery, finds it difficult to do. The writer has had

[1] See "Evolution of Sex." Geddes and Thompson.

during his thirty-four years of professional service the assistance of both sexes, and can say, fearless of contradiction, that men are better able to maintain that patience and quiet demeanor which are necessary in the schoolroom."

The relation of the two curves for males and females in the study of Assault is corroborative of this opinion.

Considering the slight effect of the wind, as indicated by the curves upon the charts, a surprisingly large number of the notes make mention of this condition as having an adverse effect. This was expected from the Colorado returns—in which, indeed, it was universally mentioned as the most potent factor—but not in those from lower altitudes. Since, however, notes were appended to but a small proportion of the questionaires, the more exact data expressed by the curves are probably more valid. The only other condition of weather which received more than a single mention was snow.

One teacher says, "A cold, snowy day, children restless and noisy." And another, "A day upon which there is snow seems (in case of boys) to bring all physical activity in them out, and makes them reach a high pitch of physical excitement." It seems to me possible that this is, in part at least, due to the participation in the active sports which snow makes possible. Coasting and snow-balling are always most attractive to the boy; and an impatience to be out of doors, even if the accompanying meteorological conditions were not directly operative, might bring about just the emotional conditions described.

Interesting as are these expressed opinions, from a scientific standpoint they cannot have the weight which the exact data must carry. Both, to be sure, are based upon the judgment of the teacher; but in the tabulation of demerits we have nearly 100,000 immediate judgments, while in a discussion of the opinions expressed in the notes we have but a few, and they, liable to all the errors of introspection.

The number of data considered in connection with the study of school children is by far the greatest of any class studied. The labor, too, of securing them was the most difficult, as the records were of such a character that many volumes had to be gone over in order to get the required information.

REGISTRATION. This term, here used, is fully defined in Chapter V., so we can proceed immediately to its consideration. Of the entire number of 118,860 days registration, the distribution by months was as follows: January, 9,723; February, 8,811; March, 10,063; April, 10,041; May, 9,963; June, 9,833; July, 915; August, ——; September 7,117; October, 11,149; November, 9,816; December, 8,455.

The difference in numbers is largely due to the varying number of days in the different school months, though not wholly as is shown by Fig. 3, in which the relation is shown between the *expected* and the actual registration for each month. The *expectancy* for each month was taken as that percentage of the whole number of registrations, equivalent to the percentage of the school days of the year, occurring in the month. This shows that for the schools studied the greatest registration is in the early spring, and again in the fall and winter to the Christmas recess; while it falls during the months of January and February and at the end and the beginning of the school year. Although these studies were made for the large city schools, the conditions shown are practically those observed by every teacher.

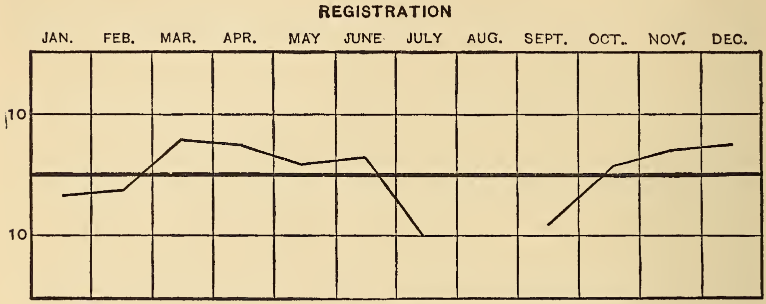

Figure 3

The sudden drop for May is perhaps not readily accounted for; but the departure for the country and the sea-shore and the late returning in the fall make plain those for July and September. The weather is probably accountable for the deficient registration in the winter only.

ATTENDANCE. Each of the figures illustrating the text of this chapter shows a curve for attendance which is not computed as are the others, with reference to expectancy. With this curve, the actual percentage of absentees is expressed for each condition, the distance of the curve below the horizontal datum line showing this. This plan was followed with the belief that this fact would be of more interest to the reader, especially if he be a teacher, than other values which would be purely relative.

OCCURRENCE. From this curve (Fig. 4) it will be seen that there was a large number of absences for January (10.7%), a gradually lessening number through

April (7.5), an increase for May (8.8), and the maximum for the school year in June.

Beginning in September with a considerable number (9.6), the minimum for the year is in October (5.4), and about the same for the next two months as for April and May. There seems to be nothing at all peculiar

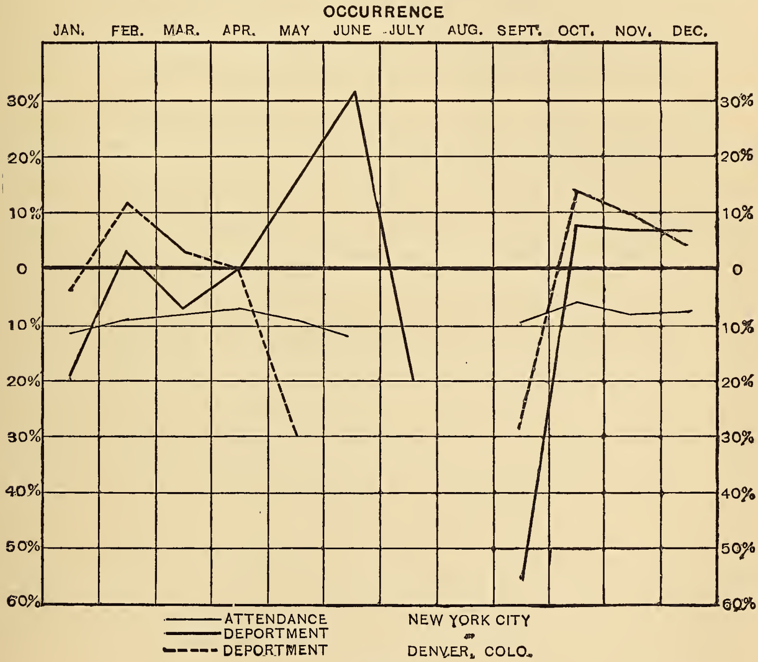

Figure 4

about the curve; in fact, it shows just about what the experience of a teacher would lead him to expect. When school-work is well under way in the early fall, it is, I believe, always more carefully attended to by the pupil than in any other time of the year. Late fall and early winter undoubtedly present more climatic difficulties to attendance than does the late spring; but as laxness in attendance has not yet developed, the showing is about the same. The bad weather of winter enforces irregularity on the part of many; and this factor, once introduced, tends to stick for the rest of the year, even though excuses because of weather conditions are not so valid. This curve shows for the very end of the year the same irregularity that was indicated by the registration. In the latter case, staying at home was officially sanctioned; in the showing for this class of data it was not.

Temperature. The attendance curves, in their relation to the various meteorological conditions, can be considered as throwing some light upon the effects of those conditions upon the health of the pupils. We cannot suppose that weather conditions, unless they be those of precipitation and perhaps very low temperature, present any great difficulties to school attendance, unless it be through inducing a state of ill health. We cannot suppose a parent would keep a child at home simply because the barometer was low or the humidity high, even if those facts were known. There are many good reasons, to be sure, why a child should be kept at home on a certain day, and it might happen that that day was one of peculiar meteorological conditions; but we have a right to suppose that for the 108,020 pupil days considered such accidental coincidences would correct each other's effects. If, then, there be any noticeable relations between fluctuations in attendance and meteorological conditions, the inference seems valid that the conditions were attended by physical indisposition or a state of low vitality on the part of the child. The temperature curve (Fig. 5) shows that there is a fluctuation in attendance with respect to the conditions indicated. The maximum number of absentees (15%) is shown for the lowest temperature group. As has been suggested, this perhaps indicates no prevailing condition of ill-health, but an unwillingness on the part of the parent to trust the child out of doors in such intense cold. The decrease, however, for temperature above daily mean of 60° may indicate the relaxing effect of great heat, which is fully

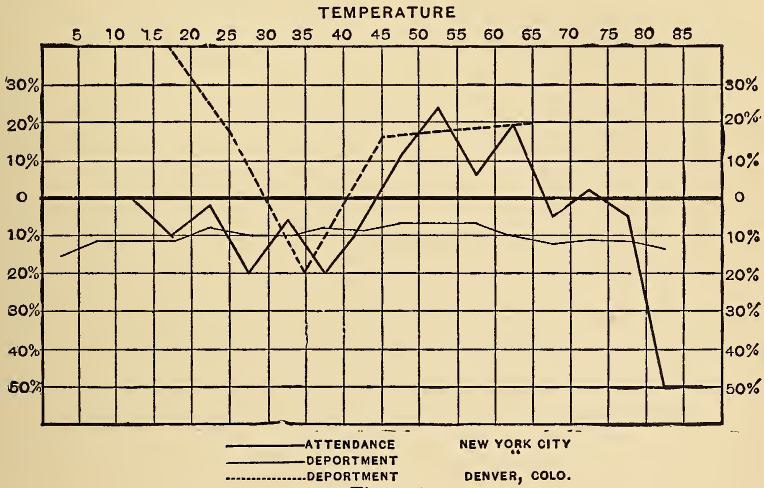

Figure 5

recognized and plainly shown by curves for other classes of data. It seems improbable that parents would fear the effects of temperature of the group 65° to 70° upon a healthy child, and thus keep him at home; yet under those conditions of temperature we have the second largest percentage of absentees. This is an interesting fact when we consider that those unseasonably hot days of spring and fall, which will be shown to have such a marked effect upon the crime of assault, are of the character indicated by this group. There seems little doubt that they lessened the vitality of the child, and that he was at home being nursed by a fond mamma. The maximum of attendance is indicated by the groups 45° to 60°.

It is very likely that fluctuations in some of the curves may be caused by accidental conditions which cannot, in this study, be discovered, and that only general tendencies in a curve have any value; yet when we note that the most bracing days of our winter climate, those days when the cold is invigorating without being intense, when the streets are dry even though there be snow upon the ground, are of just this character, we are inclined to doubt whether accident be the sole cause of the full school-room.

Barometer. An inspection of this curve (Fig. 6) discloses the fact that attendance was relatively poor during both extremes of the barometric register, and at its best when the barometer was a little above its normal

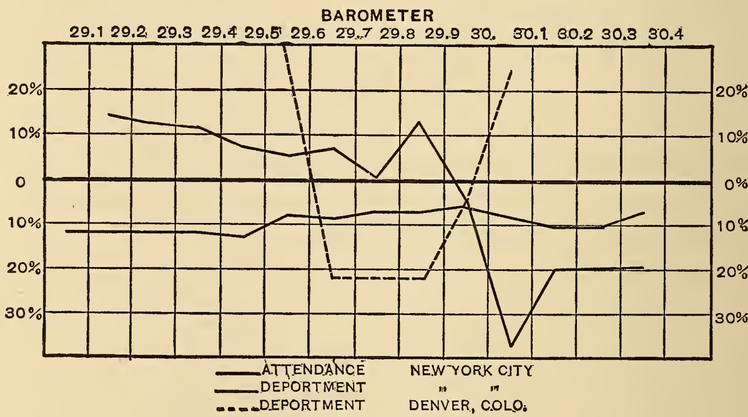

Figure 6

mean. Its fluctuations for the groups between 29.40 and 29.60, so far as I am able to judge, are accidental in their origin. Reference to the chart of Monthly Means

(Fig. 2) shows us that the barometer is normally high for the fall and winter months, and low for those of the rest of the year. There is here no constant relation shown between high and low barometric readings and the barometer for those months of the year in which attendance was greatest, by which the peculiarities of this curve can be accounted for; and our conclusion must be that the barometric conditions themselves, or the meteorological influences which vary with them, affected the children in such a way as to make it impossible for them to attend. As the barometer is usually low during storms, as well as just preceding them, it may be the latter which were really the affective agents, though showing upon this curve because of the coincidence of conditions. It is a well-known fact that for some little time before storms of unusual violence, sometimes as much as forty-eight hours, a condition exists which strongly affects many people both physiologically and mentally. Persons afflicted with rheumatism and gout, and even those troubled with corns, seem to have intimation through the affected parts of the approaching atmospheric disturbances, and it does not seem improbable that children may in some way be influenced.

Humidity. This curve (Fig 7) also shows accompanying variation in school attendance. Disregarding slight fluctuations, we have twice the number of absentees when humidities are very low or very high, as for certain intermediate conditions. It is not hard to account for the decrease in attendance for the higher readings, as they invariably accompany precipitation. Besides this, the de-energizing effects of the high humidities accompanied by high temperatures are recognized; although the fact fails to show itself fully, it is illustrated by certain curves discussed in the chapter treating of the

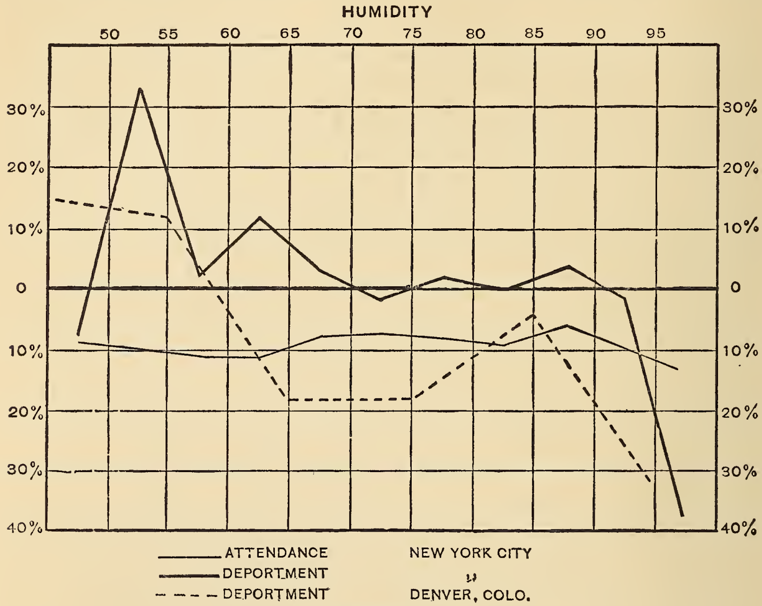

Figure 7

death-rate. If, however, the combination has influenced this curve, it would be through conditions of health, indicating that the children were at home suffering from ailments due to the low conditions of vitality induced. The decrease in attendance indicated for the lower humidities is not easily accounted for by any regularly accompanying conditions of the weather which would present physical difficulties to getting out. Storms are rarely known for such conditions. We cannot, however, doubt an adverse effect, for the other curves upon the chart indicate an excess of abnormalities in conduct. This matter will be taken up with more detail in the discussion of the curves for Denver, which show such peculiar results for abnormally low humidities; but there seems little doubt that the uniformly increased electrical potential of dry air is the cause.

It has been demonstrated[1] that for every point upon the surface of the earth there are lines of electrical force radiating outward into space, generally negative in quality at the surface, gradually decreasing in potential and terminating in an electrification of the other quality at some unknown distance in space. It is also a well-known fact to scientists that the potential of these lines of force is much greater when the air is dry than when it is moist; when the humidity is great, practically disappearing; but when it is low, attaining a great magnitude. The exact physiological effects of this highly electrified state of the atmosphere have not all been determined, but it is certain that it induces a state of nervous tension which any one who has lived in an excessively dry climate cannot have failed to notice. Upon the arid plains of some of our more elevated Western States, Colorado, Wyoming, and Utah, especially, it is a factor which affects the emotional condition of the people in no small way, and undoubtedly has brought about the excessive rise in the curves for the Denver data, as shown upon this chart. Although the electrification is usually less for cities than for the country, and is never excessive for climates as humid as that of New York, yet it may have had its effects upon the curve under consideration. If so, it would indicate that the children were at home suffering from nervous conditions which seemed to the parents to warrant missing school for the day.

[1] See Smithsonian Report, 1895, p. 90 *et seq.*

WIND. The attendance curve (Fig. 8) for this atmospheric condition shows no important variations except for very low and very high movements. The latter is easy to account for on the supposition that during a hurricane—such as a movement above 700 miles for the day—the children were kept at home because of the physical difficulty of getting about. It does not seem

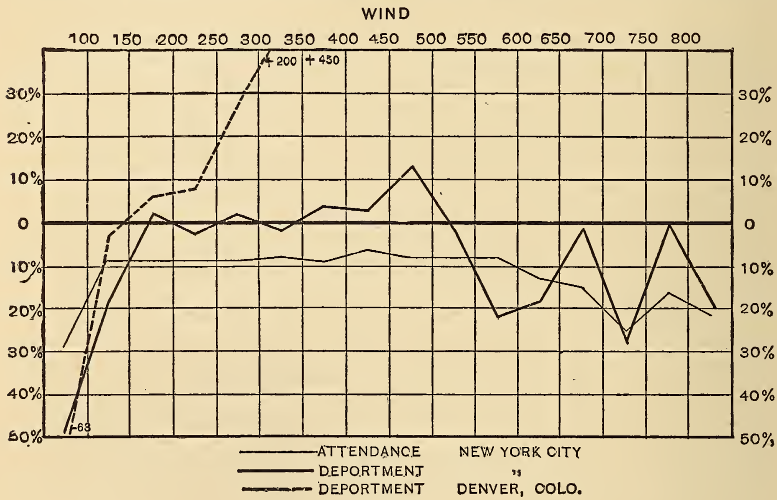

Figure 8

probable, however, that the decreased number in attendance for days on which there existed a virtual calm can be thus accounted for. This it seems to me, must be an indication of disastrous effect of the condition upon health.

With regard to the effect of calms upon health, so far as I know, the only thing published is by F. A. R. Russell, vice-president of the Royal Meteorological Society,[1] in which he states the results of a study made

[1] Smithsonian Report, 1895, p. 294.

of the relation between the death rate in London and the prevalence of low wind velocities. The conclusion of this study, briefly stated, is that the death rate for that city is considerably larger during months having many calm hours than for the months next following; or for the same month in other years when the number of calm hours is materially less. To give an example from his figures of the period from November, 1872, till December, 1893: "On the whole, the mortality is greater for calm than for windy weather, and there is much less variation in the death rate during the prevalence of strong winds than during the prevalence of gentle winds and calms."

Although these figures are for the death rate, and that is in no sense a factor in our study of school attendance,

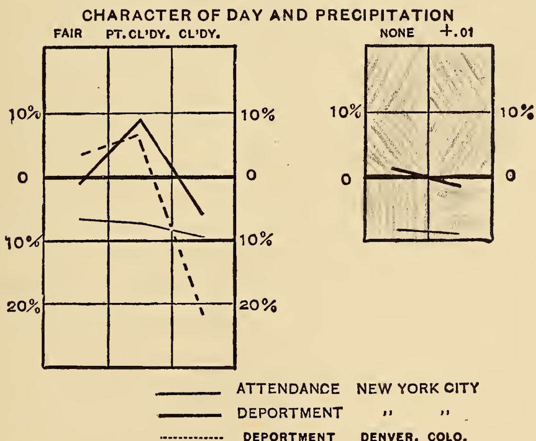

Figure 9

still the latter is an element which varies with conditions of health, and may be taken as an indication of its state. It has also been shown that during conditions of calm the number of disease germs in the air is much greater, especially in large cities, than under other conditions; but since few germs are known to produce sickness upon the same day as taken into the system, this fact need not here be taken into consideration.

Character of the Day. We cannot be certain that more is indicated by this curve (Fig. 9) than the direct effect upon attendance, of the physical difficulties of getting about during storms. Possibly the difference between the attendance on fair and on partly cloudy days is due in part to fear of a storm on the part of the parent, as indicated by the weather conditions; although days characterized under the latter head might be stormy at the beginning of the session, and hence prevent attendance. The exact differences between days of the three characters may be seen from Fig. 9.

Precipitation. Nothing more need be said under this head than is included in the preceding.

DEPORTMENT. The attempt to discover the effect of the weather upon the children of the public schools, as shown by their deportment, was the first phase of the present problem undertaken. Indeed, in its inception it was the only study anticipated. As the work went on, however, the field broadened, and, one after another, interesting subjects of a cognate character presented themselves, until various classes of data mentioned in Chapter V were included. The general opinions of members of the teaching profession upon the subject have been treated in the earlier pages of this volume, so we shall proceed at once to an inductive study of the data presented.

Occurrence. In the peculiar fluctuations of this curve (Fig. 4) we unquestionably have more strongly shown evidences of the force of other conditions than the meteorological. Certainly general tendencies which might be pointed out are due to the latter; but the peculiar ups and downs are largely due to practices and customs associated with school management. A glance at the curve shows a somewhat gradual increase in the number of demerits (it seems probable that excess for February is accidental) from the beginning of the year to June, in which month a very marked drop takes place. Again, at the beginning of the school year in September we have the deficiency still greater, with practically an equal number for October, November and December. The regular increase toward the hotter months is in accord with the showing made by other classes of data, and is undoubtedly due to the gradually increasing temperature; but the deficiencies for July and September are not to be accounted for in that way. Were it not for the fact that all the conditions under deportment are studied with reference to attendance rather than registration, we might conclude that the small number of demerits given was due to a small attendance; but since the small number of school days for these months is taken into consideration we find no solution on that ground.

An explanation which seems to me most probable, and which will, I think, appeal to all teachers on careful thought, is one based upon the standard of discipline set for different parts of the school year. At the beginning it takes some little time for the routine to become rigid, and a laxness is allowed which would not be tolerated during other months. I believe also that at the end there is a like *decrescendo* in severity. A teacher recog-

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nizes the fact that in the few days remaining a misdemeanor cannot become habitual and rather than end the year with trouble she lines her path and that of her pupils with roses, by overlooking many things. Both of these tendencies would lessen the number of demerits, and we here have indications of the fact. It is not certain that the slight excess in the number of demerits for the last three months of the calendar year is brought about by the meteorological conditions. The heavy horizontal expectancy curve is in a sense an average for all the occurrences studied, and any condition forcing the curve either up or down must be compensated for by an opposite showing in some other point. The excesses for these three months may be due to the fact that the normal, or expectancy, has been so affected by the forced deficiency for the beginning and end of the school year as to leave the curve elevated at the other points, with the results noted. This factor of compensation is one common to all the curves.

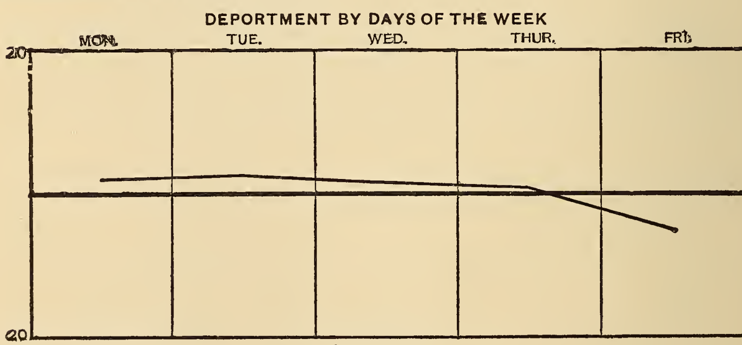


Figure 10

The occurrence of demerits for the days of the school week is shown upon Figure 10. It indicates a deficiency of 5 per cent. for Friday, and a compensating excess distributed quite evenly for the other days of the week, though a little the greatest for Tuesday. Somewhat surprised at the fact that Friday should have been such a perfect day in deportment, I studied the data a little more closely, and discovered that it was brought about by the dominating influence of one school from which about 80 per cent. of the data had been collected. The other three schools studied showed Friday to have been the bad day of the week, but the excessive "goodness" of the children of this school had entirely negatived the result. Upon questioning the principal of the larger school in regard to Friday's program and a possible explanation, an interesting solution of the mystery was disclosed. The principal said that good order was maintained largely through an emulation on the part of the pupils to secure honorable mention at the close of Friday's session for the best deportment in the room for the week. Also, that the pupils were conscious that the teachers were on that day considering the honor roll for the week, and it seemed probable that they were all doing their best in the hope that, because of their perfection for that day, misdeeds of the earlier days of the week would be overlooked, and so the coveted prize won. It was also stated that the school session was one hour shorter on Friday than on any other school day. Both of these causes would have their effects upon the curve, though the latter would have been equally potent for any of the schools studied.

Occurrence—Denver. The monthly occurrence curve for Denver (Fig. 13) shows all the peculiarities of that for New York, except that of increased disorder with the approach of the heated season. The school year is considerably shorter, practically closing with May, instead of extending into July, though it begins somewhat earlier in September. We note the same excess for February, which in the case of the curve for New York was attributed to accident. Coincidences of this sort would argue definite causes which were common to both places; but what they really are it is not easy to see. For Denver the wind, which is high for the month, might be a factor; but if so, we should expect a still greater effect for the month of March, when it is still higher. This, however, is not indicated. The lack of increase in the number of misdemeanors for the heated months tallies to an extent with the showing of the temperature curve, discussed in the next paragraph. There we see that high temperature indicates a deficiency of the data considered.

Temperature. The seeming effect of temperature upon the children in the public schools both of New York and Denver, as shown by their deportment, is different in some respects from its effect upon any of the classes of adults studied. I believe, however, it can be shown that the conditions under which we are studying them are sufficiently unlike to account for at least a great part of the differences in their curve. Reference to the temperature chart (Fig. 5) shows a less number of demerits for temperatures below 45°, an excess for the groups up to 65°, and again a deficiency for those which are higher. The lessened number for all the low degrees is fully in accordance with all the results of studies of the effect of cold climates upon physical and mental activities, and is suggested by the occurrence curve, already discussed. It is a well recognized fact that under conditions of low temperature so large a portion of the vital energy is consumed in keeping the body sufficiently warm to allow a continuance of its metabolic processes, that little is available for deportmental excesses, and a condition of comparative lethargy exists. With an increasing warmth in the atmosphere this energy is diverted into other channels, and its expenditure is made known in more conspicuous ways. Nearly all the curves upon the temperature chart show this fact. Temperatures above 65° show the opposite effect upon the school children only, by decreasing either the energy

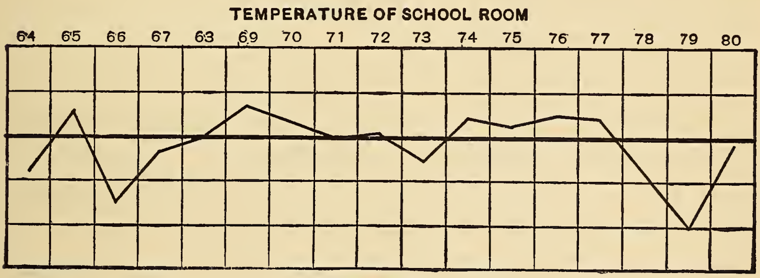


Figure 11

at command or the irritability which shows itself in bad conduct. Upon noting the material deficiency of deportmental excesses under very high temperature both for New York and Denver—for the latter place to the extent of 300 per cent.—it occurred to me that it might be due to a difference between the temperature in the schoolrooms and those recorded at the Weather Bureau.

The school buildings of the city are large and well ventilated and even in summer are comparatively cool, so it seems quite probable that the contrast on a summer day with the excessive heat without might have a quieting effect which would be noticeable in the curves. The fact that the temperature of each school-room is taken three times during each day's session, once at 10.30 a. m., once at 1.30 p. m., the beginning of the afternoon period, and again at 3.30, and that these readings were recorded in the registers placed at my disposal, made possible a study which has thrown some light upon the questions. The curve upon Fig. 11 gives the result. In this curve, as in all the others, expectancy was computed by reference to the number of times the different temperatures, indicated at the top, occurred. It will be noticed that most of the marked fluctuations of the curve are for temperatures for which the number is odd rather than even. This is undoubtedly brought about by the small number of data recorded under the former conditions, due to the fact that the thermometer scale is divided into units of two degrees each, and the great majority of the teachers recorded the temperature in the nearest even number. There is a great lack of regularity in the curve; but if it shows anything, it is that for the highest temperatures recorded, which, in fact, run up only to 80°, there is a deficiency of demerits, while for those between 77° and 69° (with the one exception of 73°, which is an odd number) there is again a deficiency. I do not consider this curve an especially valuable one, yet its indications are somewhat interesting because of their similarity to those of the temperature curve for the year—that is, an excess only for moderately high temperatures. From this fact, I would conclude that it was not wholly, if at all, the contrasting coolness of the school-room which kept the deportment good for the excessively hot day, but a relaxing effect, producing a low state of vitality which did not furnish sufficient energy to force an output in frolicsomeness. This last is true both for unusually high temperatures in the school-room and for the general meteorological condition; so much so for the latter, and so markedly in contrast with the curves for adults, as to lead one to conclude unquestionably that this effect of great heat is much greater upon the child than upon the adult. Whatever relation may exist between them in the quantity of energy each may have in reserve above what may be demanded under ordinary conditions, certain it is that in periods of excessive heat the surplus of the child seems to be exhausted much more quickly. This fact is borne out by the more rapid increase in the death rate of small children than of adults under high temperature, and, I believe, by our common observations in the matter.

Temperature—Denver. In considering any of the classes of data for Denver, it must be borne in mind that the numbers are much less, because of the smaller population of the city, and on this account accidental influences are much more liable to be effective and thus bring irregularities into the curves. We shall consider then that only general tendencies are valid, disregarding, for the most part, minor fluctuations. Attention should also be called to the larger meteorological groups made use of for most of the conditions. In the study of temperature, for instance, in New York, comparisons were made for each group of 5°, while for Denver 10° were taken as the unit. This is the case simply because the study for the latter city was the earlier one, and the larger groups made use of with the thought that they were exact enough. In attempting the more elaborate study for New York, it was thought best to divide the groups, even though the labor was thereby nearly doubled. Upon the charts the heavier of the vertical lines indicate the limits of the Denver groups.

Upon inspection of the curve under consideration (Fig. 5) it will be seen that there is a general resemblance to the same curve for New York, though with an intensification of the latter's results. The great excess for conditions of very low temperature is not valid, it seems to me, from the standpoint of meteorological effect: First, from the fact that the number of data for such temperatures is so limited as to make them very easily influenced by accident; and second, from the character of the data studied in Denver, such accident is very probable. Those data, it will be remembered (see page 63), were not the giving of demerits for bad deportment during the hours of the session, but the administration of corporal punishment for some misdemeanor of considerable magnitude. Misdeeds quite as frequently occurred about the school building before and after the session as during its period, and in the winter months snow-balling and the accidents connected with it were very prolific sources of the youngster's tribulations. As this pastime could only be indulged in under the condition of temperature indicated by the lower part of the curves, and as there is not, perhaps, anything quite so seductive for other temperatures, its effect may have been considerable.

Even if we are correct in inferring that this is a factor, we cannot assert that it accounts for the entire excess in cold snaps. It does not seem impossible that the disregard of everything else, which we are conscious of when aching with cold, may have introduced conditions of disorder which could not be overlooked by the teacher, and so the number of castigations was augmented. The decrease under conditions of great heat may be accounted for in the same manner as the similar showing for New York, already discussed—that is, a contrasting coolness of the school-room with the atmosphere without, or the devitalizing effect of high temperatures, or both. The study of the temperatures of the New York schoolrooms would lead us to believe the latter effect to be the more powerful, reducing the number of misdemeanors, under such conditions, three-fourths.

Barometer. The effect of those conditions of the atmosphere revealed by different readings of the barometer, seems to be somewhat constant for all the classes of data (Fig. 6). With the sole exception of the study of errors made by clerks in banks, that effect seems to be one of increase of all the occurrences for conditions of low barometer and a corresponding decrease for readings above the normal mean. Notwithstanding the fact that the pressure of the atmosphere, varying as it does for a given locality, has been considered by many a great force in disturbing the mental equilibrium of the people, I believe, as has already been stated, that it does so largely through its production of other states of weather, which are themselves the efficient cause. This is not true, for the other meteorological conditions, as temperature, humidity and wind, have their effects *per se*. As stated under the discussion of attendance, from the standpoint of our present study the barometer is most interesting in its relation to other conditions of weather which are themselves influential. Those upon which its variations have a causal effect are the character of the day and precipitation, and this relation is very interesting. Conditions of low barometer are usually the accompaniment of storms, although a careful study of this relation for several years shows that when a storm is of several days' duration the period of depression exists only for a short portion of the time. That is, although it is practically true that all days on which the barometer is low are stormy days, not all stormy days are those of low barometer. Now, although the curve under consideration shows an excess of demerits for low barometers, those for character of the day and precipitation (considered in full later) show a deficiency of them both for cloudy days and for those on which there is rain or snow. Our conclusion from this must be, then, that the demerits which have brought the curve above the expectancy for low barometers must have been given on the particular stormy days which presented those conditions, while stormy days when the barometer was higher were sufficiently free from demerits to force their average below the expectancy and give us a deficiency for the condition as a whole. The general tendency of this curve for the school children compared with the others, all of which are for adults, would lead us to believe that the effect of the condition, whether immediate or secondary, is less upon children than upon adults. We must, however, take into consideration the fact that all these conclusions, which we are imputing to the effects of weather upon the children, may be little more than their effects upon their teacher.

The award of demerits is, of course, made in accordance with the judgment of the teacher, and a fluctuating criterion or a judgment warped by subjective emotional abnormality would give us the same results as a valid judgment of an affected object.

Barometer—Denver. Low barometers bear the same relation to the occurrence of misdemeanors for the climate of Denver that we have noted for New York, except that the effect seems to be intensified. For high readings it seems to be reversed, and at that end of the curve we again have an excess. The conditions of atmospheric pressure are, however, very different for the two places; for we must, in reading the exact height of the mercurial column for Denver, subtract five inches from the readings given at the top of each column. There seems to be nothing new to be said with respect to this curve.

Humidity. The general tendency of this curve (Fig. 7) is to indicate an excess of demerits for conditions of low humidity, compared with the numbers shown for a moist air. Comparing it with the curves of the other classes of data, in which an emotional state affecting conduct can be considered a factor (Assault, Penitentiary and Insane), we find this tendency less marked for the children than for the adults. Judging from the answers to the questionaire with respect to the effects of "muggy" and "sticky" weather, I am inclined to think that this showing will be something of a surprise. The curves mentioned resemble each other so closely in their general tendencies that when we consider that nearly 100,000 data were made use of in their construction, we can hardly doubt their validity. Of the special curve under consideration, the marked fluctuations for both the end groups may or may not be due to accident. That of the group .45-.50 is much more liable to be so than one at the other extreme, for less data were considered in computing its position than for the latter. The curve coincides wholly with the condition which we find for character of the day and precipitation, as all these show deficient numbers of data for conditions of moisture. Our inference from this curve must be that excessive restlessness, together with those activities of mind and body which in the judgment of the teacher constitute disorder, increase with increasing dryness. Yet a dry atmosphere is recognized the world over as a vitalizing one, having the bracing properties which we all recognize in certain characteristics of weather. A logical conclusion for the two conditions stated, is that bracing conditions of atmosphere and an excess of activity accompany one another, or, to carry the logical process a little further, that those activities depend upon and are the result of excessive vitality.

In arriving at conclusions thus, by an inductive process, we are not, of course, supposing that every individual of the aggregate is subject to this law. There may be many whom such a vitalizing effect would rouse only from a chronic state of physical and mental lethargy to a condition common to the rest under less stimulating conditions; but for the pupils as a whole the conclusions are valid. Interviews which I have had with many teachers upon the subject have tended to corroborate the view taken. They say that two tendencies on the part of the pupil are to be combated—inattention and roguishness; and, however differing might be the views of individuals with regard to the distribution of the latter, the former was more prevalent, they thought, on stormy and wet days. The present study would tend to prove roguishness more common when the weather is dry and clear. This is noticeable when we consider that lapses of attention would not be so apt to influence the giving of demerits as conduct that was objectively bad. The sins recorded there are those of commission rather than of omission, as inattention would affect the class-standing rather than the record of deportment.

The cause of the exhilarating effect of a dry atmosphere seems to be the increased electrical condition accompanying it; but since this is much more markedly shown for the climate of Denver, we shall discuss it in the next paragraph. The sudden increase in the number of demerits awarded for the highest group of humidities is not wholly due to accident. It seems to me probable that we may attribute it to an utter lack of the power to inhibit, brought about by the relaxing effects of such an atmosphere. We have all recognized, I think, in ourselves or in others, a mental state brought about by weakening and relaxing influences in which any impulse was followed by its motor realization simply through an inability to control. The threshold of such a condition seems to be fairly well definable and not at all gradual. It comes after those stages of relaxation in which there is scarcely enough energy left to initiate activity, and generally shows itself in a condition of excessive nervous irritability. Although the other curves for data of this nature do not show it, and our conclusions may not be well grounded, still the possibility is, I believe, worthy of mention.

Humidity—Denver. Figure 6, which shows the influence of this meteorological condition, is not so constructed as to exhibit this curve in full for want of space, since if it did, it would have to be ten times as high as it is represented. The seeming effects of extremely small humidities, from ten to forty-five, is most startling, giving us an excess of floggings for the Denver school children of 400 per cent. When we consider that this means that for the fourteen years studied, the days on which the humidity showed a mean of below 30 had four times as many punishable misdemeanors as the law of numerical probability would lead us to expect, we cannot doubt the effect of such conditions, especially when the three curves show the same effect in different magnitudes.

To one who has lived in Colorado and has experienced these conditions, indicated by the lower end of the curve, the results, although perhaps surprising, are still fully credible. The effect upon the school children, and, indeed, upon the people as a whole, is easily recognizable, and has been alluded to in the answers to the questionnaire coming from Colorado. The effect seems to be, primarily, an excessive stimulus to nervous discharge. The low humidity common to Colorado and the higher altitudes (see Fig. 7) makes this condition, to an extent, a permanent one, and has been alluded to in Chapter VI. But even the chronic state of neurosis prevailing under normally low conditions of humidity is capable of intensification under those still lower, and these are what our curves give us. By "the chronic state of neurosis" referred to, I do not mean a pathological condition, but a slightly increased nervous tension which all except the strongest and most phlegmatic feel. It shows itself frequently in mild insomnia or an occasional irritability of disposition, though not in melancholia. Even the horses are not free from the influence, and seem to be more nervous and excitable than their species in lower altitudes. This has been especially noticeable in highly bred horses which have been brought to Denver and Colorado Springs for track purposes. Not infrequently the effect has been such as to give their trainers much anxiety as to their ability to control them at all under the super-exciting conditions of the race. When, however, both with racing horses and human athletes, the effect has not been sufficient to bring on other complications, the available energy for rightly directed motor discharge has been increased, and some astonishing records are the result. The effect upon the mental worker is also recognizable. Work is, for the most part, turned off under higher pressure, with the necessary consequence that it generally cannot be so long maintained without a resulting condition of partial collapse ensuing, which demands a brief sojourn at a lower altitude for its relief. Ministers, teachers, lawyers and professional men generally feel this especially, and recognize the necessity of longer vacations than were needed by them when working at lower altitudes. The school year is shortened in accordance with this requirement, and even then the mental collapse of both pupil and teacher is usually greater than that felt by them at the conclusion of the longer school year in a more humid climate.

These effects are, I believe, not the results of dry air *per se,* but of its universally accompanying electrical condition. As was stated in Chapter VI., the earth, for its entire surface, has been found to be charged with static electricity of a negative character. This is not supposed to be a property of the earth itself, but to be generated by the fricton of objects on its surface and of air particles set in motion by the wind, under a discussion of which condition we shall again allude to it.

It is also supposed that the potential of this static charge at the surface of the earth is directly proportional to the non-conductivity of the surrounding atmosphere. If this were an absolute non-conductor, its effect would be similar to that of the glass of a Leyden jar, the earth representing one of the tinfoils of the jar and the clouds representing the other; but the properties of electrical conduction of the atmosphere decrease with its moisture or humidity, with the necessary consequences that those portions of the earth's surface which are insulated by a very dry atmosphere are continually being charged without being able to discharge convectively their burden to the clouds, or the higher strata of air which contain electricity of the opposite character. As a consequence, those regions where the humidity is low are normally more highly charged electrically than regions where the conditions of humidity are the opposite, and those regions themselves vary with respect to the potential of their charge as the humidity varies, the potential being strongest where the humidity is lowest. Actual experiment has proved that this potential is sometimes very high. Professor Arthur Schuster, F. R. S.,[1] says of it: "The strength of this electric field is not at all insignificant. If we wish to produce it artificially, between two parallel plates kept one foot apart, we should have to apply an electro-motive force sufficient, and sometimes more than sufficient, to light up the

[1]Smithsonian Report, 1895.

incandescent lights of our dwellings. The electric force is comparatively weak in our country (England), but 50 volts per square foot are constantly observed, and 100 volts are not uncommon; but *in drier climates the amount of force may be considerably in excess of these figures.*" The latter condition is certainly experienced in Colorado; though, as far as I know, no definite experiments have been made there to determine its magnitude. Although the electrical condition is observed for the surface of the earth, objects upon its surface would have a still higher charge. The increased tension for the static charge for projections or points upon the surface of the conductor is well known, and a human being or any other object upon the surface of the earth under such electrical conditions would show more than the full potential of its support. This tendency of the static charge to rush to points on the surface and thus discharge itself by convection gives rise to the phenomena of St. Elmo's Fire, or the so-called Castor and Pollux of the ancients, and also curious electrical manifestations sometimes observed on the summits of high mountains. It has been observed that the electrical potential of the air is less in the vicinity of larger towns and cities than in the open country, especially if it be free from woods. This is due in part to the effect of the numerous points presented by the buildings of the city, but still more largely, in all probability, to the discharging effects of the gases and columns of heated air arising from fires. Professor Schuster, in the paper already referred to, mentions the effects of these results of combustion, and concludes that their influence in reducing the potential in thickly settled regions must be tremendous. He says: "It follows that every fire burnt on the surface of the earth, and every chimney through which products of combustion pass, act like very effective lightning conductors, and would consequently discharge, slowly but surely, any electrification of the surface of the earth. The peculiar immunity of factory chimneys against damage by lightning appears from statistics collected by Hellman in Schleswig-Holstein, for which, while 6.3 churches per thousand were struck, and 8.5 windmills, the number per thousand for factory chimneys was 0.3. It will be noted that although the action of lightning is mentioned in this quotation, the electrical conditions of the atmosphere which we have been considering are those normally prevailing without lightning or any visible electric phenomena. During a thunderstorm the potential of the earth's surface runs up to many times that of other occasions, but in the present study the mental effect of such conditions will not be considered. They are not frequent enough in most localities to form an important factor in the cosmical environment; and, moreover, during the occurrence of an electrical storm the whole emotional condition of the school is so affected by fear or awe in the presence of such tremendous phenomena that no demerits could, with justice, be awarded which could be used as data for an inductive study like this.

In order to determine a little more exactly just what fixed relation exists between various meteorological conditions and the electrical potential of the atmosphere, I carried on the following simple investigation:

The study is based entirely upon T. C. Mendenhall's "Reports of Studies of Atmospheric Electricity," which appeared in 1889 as a memoir of the National Academy of Sciences. This comprises all the work done by the Signal Service in an attempt to investigate the value of electrical observations as an aid to weather forecasting. The mass of material collected cannot fail to be of value for subsequent study. For the years 1882 till 1889, stations were maintained for a part or all of the time at Washington, D. C., Baltimore, Md., Cambridge, Mass., New Haven, Conn., Ithaca, N. Y., and Columbus, Ohio, where, under competent observers, the electrical potential of the atmosphere was determined by means of very delicate and expensive instruments each day, at intervals varying from a few seconds to several hours. Of the many interesting facts brought to light by this study, I have used but one, the mean potential for each day as recorded at the Ithaca station. The records from this station were not chosen because they might prove more interesting than those from any other, but because they gave certain other meteorological data for each day which could be used for purposes of comparison. These appended data dealt only with the character of the day, the wind, and the precipitation. Neither the temperature, the barometer, nor the humidity were given, so that we have no data bearing upon them, except as the latter may be inferred from the character of the day. The study, as set forth in this paper, consisted simply of a tabulation of the mean potential for each day with reference to the other conditions given for the day, for the purpose of discovering under which of the latter the potential was normally high or low. As an illustration of the records from which I have worked, I give those of a few days from the Ithaca report:

June, 1887.

Day	9 a. m.	11 a. m.	1 p. m.	3 p. m.	Mean	Remarks
1	203	88	14	139	111	Br. Cloudy. Rain
2	38	—181	258	95	52	Lt. Cloudy. Rain
3	—44	11	11	22	0	Cloudy.
4	66	2	82	13	41	Fr. Clear.
5	137	84	71	126	104	Lt. Cloudy.
6	154	137	57	137	121	Lt. Rain.

The numbers refer to the electrical potentials in volts, under "Remarks." The first abbreviations refer to the velocity of the wind, and have been interpreted for me into terms of miles. The other abbreviations indicate the character of the day and the precipitation. The means for each day represent the algebraic sum of the observations for the day.

The following table shows the mean potential for each of the meteorological conditions alluded to in that column in course of the report:

Character of Day.			Wind.				Precipitation.	
Clear.	Pt. cl'dy.	Cloudy.	3–5	6–14	15–29	30–39	None.	Some.
93	68	56	52	126	151	254	80	52

As may be seen by the table, the potential is the highest on clear days (93 volts) and those having considerable movement of the wind (254 volts for velocities of from 30 to 39 miles per hour), decreasing as the moisture increases (52 volts on rainy days), and as the wind subsides (52 volts for velocities of from 3 to 5 miles). The records did not furnish data for the determination of the potential, so this was approximated by taking the average of the potentials for clear and partly cloudy days.

This study corroborates in a very decided manner the hypothesis stated both in the paper alluded to, and also in a more extended article on the same general subject.

We cannot, however, claim for it a very broad bearing; simply that the figures are true for a limited study made from the records of a single station. That they would prove valid for any other locality, we cannot be certain. No electrical data are obtainable for New York City or Denver, Colo.,—the cities to which my studies of the influence of the weather upon mental states have been limited; and as they can only be obtained by the use of very expensive instruments, are practically impossible, except under the direction of the Government. Until it is done, we must rest content with analogies based upon studies made elsewhere.

In regard to the exact manner in which the electrical condition affects us little is known. Further study along the lines of electro-physiology and psychology may demonstrate this to a certainty; but for the present we must satisfy ourselves with what little light we may show upon the magnitude of this effect alone.

Wind. The effects of the wind upon the emotional states of the various classes of individuals as disclosed by this study have been something of a surprise. In spite of the fact that we so frequently hear people deploring conditions of considerable movement, and asserting that the wind "makes them nervous," the curves taken as a whole fail to show that high winds for the climate of New York have any effect disastrous to mental quietude. In fact, these effects seem to be the reverse, for, in spite of many fluctuations—increasing as the data for the groups becomes less—the general tendency of the curves is downward as they show increasing velocities from the 100-150 mile group. This is not so plainly marked for the curve under consideration (Fig. 8) as in some of the others for adults, yet that portion for movements above 500 miles indicates noticeably less data than that for the 350 miles preceding. The marked deficiency for the lowest movements recorded I am at a loss to account for, although it is much more fully discussed later in this volume. It cannot be discovered by studying the meteorological tables that such conditions are the usual accompaniments of other meteorological states which have shown a deficiency of data; nor has it seemed to be a fact of general experience that days which were virtually without wind—as those registering less than 100 miles—have had a soothing influence. Yet the uniformity of the curves in this respect leaves no room for doubt. It may be that we have a solution in the relation which seems to exist between conditions of calm and the vitality of human beings. We alluded in our discussion of attendance in the schools to discoveries with regard to these effects upon the death rate in London, and we have here evidence of an increase for days when the movement was very small. If, then, perfectly calm days have a devitalizing effect, in accordance with our theories already stated, that a certain excess of vitality is necessary to conduct warranting demerits, we might expect just the deficiency indicated by the curve.

From the 150-200 groups, the curve shows a gradual, though slight increase in data till we reach the 500 mark, when it declines again, the excess for the highest movement being quite likely due to accident liable to the small number of data for the group. Any attempt to account for these peculiarities in the general tendency of the curve would be little more than guess-work, although several of the other curves show practically the same conditions. It would not seem improbable from their showing that while very slight and very excessive movements affect the vital forces at command in a negative manner, the velocities between these extremes have an opposite effect, though not a very marked one, and for the latter condition alone do we have excess of the occurrences studied.

WIND—DENVER.. As was the case with the preceding, Figure 7 does not show the higher portion of the curve expressing the seeming influence of the wind upon the Denver school children. That portion of it which is shown, and the numbers at the top of the column for movements from 250 to 450 miles, show that its effect in such a climate is tremendous compared with what it is for New York. While those for the latter city do not diverge far from that of *expectancy* in the dry Colorado climate, movements of only a moderate absolute velocity are accompanied by nearly five times (+470%) the normal number of misdemeanors in the public schools.

A fact most surprising to one who has lived in that climate is disclosed by the chart of monthly means (Fig. 1). It is that the movement of the wind for the year is only about one-half what it is for New York. This seems hardly credible to a Coloradoan, for the severest criticism of his climate which he hears—indeed his own before he becomes so enthusiastic over its virtues as to fail to see its defects—was on this very score of wind. The curves under consideration, however, undoubtedly prove that he has been judging the velocity of the "Colorado zephyrs" by the effect which they produce upon his mental state rather than by the anemometer record, and in this way has read into it a velocity which did not exist.

By noting the wind groups covered by the Denver curves it will be seen that the greatest movements occurring for all the years studied were between 450 and 500 miles, and though there was but a small fraction of one per cent. of such days, yet their effects, and those, in fact, of all movements above 250 miles were tremendous. The undoubted cause of this was alluded to in our discussion of the effects of low humidities in such a climate. That the wind alone is not productive of such results is shown by the study of its influence for the climate of New York. There, those velocities which are so disastrous for Denver seem productive of no mental effects whatever.

As was said in the paragraph just referred to, the electrical potential at the earth's surface nominally increases in an inverse ratio to the humidity. It may also be said with just as much truth that, humidity remaining the same, the electrical potential increases directly as the movement of the wind. The electrical state is in every respect one of static or frictional electricity, and, just as in the physical laboratory, the electrophorus takes less rubbing or the plate machine fewer turns to become charged on a dry day than on a moist one, so in the dry climate of the west a moderate movement of the wind produces effects which no hurricanes can bring about in the relatively humid east.

No very carefully tabulated data are required to demonstrate those effects in a qualitative way. When both conditions for producing the highest potential—that is, low humidity and high wind—come together, the effect upon the pupils in the schools is very noticeable. It is no uncommon thing to hear a teacher deploring the conditions because of the fact that she could "do nothing with the children." In looking over the monthly observation sheets sent by a score or more of voluntary observers in the State of Colorado to the office of the Weather Bureau at Denver, I was struck by the force of some of the comments which were frequently appended. One made by a physician in one of the smaller mountain towns upon the point under discussion, was: "Humidity for the month very low, which has set up an electrical condition that has set every one to fussing and fighting." Although he has considered the conditions upon which he has so tersely commented as due entirely to the humidity, the wind is also a factor in their production, and his characterization of the effects is too good to be omitted.

Character of the Day. Surprising as it may seem to the many who have expressed their opinions in answers to the questionaire sent out, on cloudy days the deportment in the school-room was better than on those of any other character, if we may judge by the number of demerits given. We might be inclined to be skeptical as to the validity of the curve, even though it be based upon the tabulation of 100,000 or more actual observations, and still prefer conclusions from our experience, did not all the other curves (banks excepted) show a similar deficiency of the conditions studied for cloudy days. Whole articles have been written based upon the supposed observation that the devil openly stalks abroad on gloomy days, and that crimes are multiplied under such conditions.

For the curve under consideration, partly cloudy days have quite a marked excess (9.8%); fair, about the *expected* number, and cloudy, the deficiency referred to.

On the theory of deportment which we have made use of in discussing some of the other results we should account for this deficiency upon the relaxing or devitalizing influence of gloomy weather; that under such conditions the children as a class lacked the energy to become disorderly and were comparatively quiescent, even though they were not intellectually energetic enough to do their best work. If we had a special marking system for inattention, or if I had been successful in obtaining the much desired daily marks for the class work, I am inclined to think that this hypothesis could have been proved. As it is the work remains to be done. Marks for deportment would not be likely to show such conditions, except in a negative way, and this, I think, we have here.

The excess of demerits for partly cloudy days may be accounted for by taking into consideration the effect of different conditions of gloominess upon the emotions and the states of vitality. Cloudiness seems to indicate the negative character of the former, and to decrease the available quality of the latter. On fair days, then, although vitality would be at an excess, positive emotional states—or good nature—would so direct its motor output as to make conflict with the authority of the teacher not very liable. On partly cloudy days the available energy has only been lessened to a small extent; but a markedly negative emotional condition has been brought about which directs that considerable quantum of available energy into motor channels that are disastrous to good conduct. On cloudy days, although the emotional state would bode trouble, energy is lacking, and less active disorder is possible than when a moderate amount of both its elements is present. It may perhaps be argued that such an analysis is entirely unjustifiable; that the motives which influence the conduct of the child cannot be reduced to the two-fold conflict of emotional quality and vital energy. Such a criticism may be entirely just, but will have weight in proportion to the validity of other hypotheses that may be brought forward to account for the conditions demonstrated by the data.

Character of the Day—Denver. This curve (Fig. 8) so nearly coincides with the one just discussed for New York as to leave little to be said. The quieting effect of cloudy days for the Denver climate is much more decided, and is somewhat surprising to one who has experienced it. Upon the basis of the compound influence of emotional states and vitality we must judge from this showing that for Denver the effect of cloudy weather was either less potent in negativing the emotional state, or more potent in depleting the vital reserve, or both. But both of these suppositions are contrary to conclusions which experience of the occasional cloudy days of the Denver climate would lead us to make. We seem to be conscious at such times of an especially depressing effect upon the spirits, though what the influence upon vitality may be is hard to state from introspection. The Denver curves for Suicide and Murder show an opposite effect for cloudy days from that indicated by this curve, and a fuller discussion of the probable causes will be given in the sections which treat of those classes of data.

Precipitation. The relative number of demerits given upon rainy days and upon those in which there was no precipitation is what would be naturally expected from the study for the character of the day—that is, an excess for dry days, and a corresponding deficiency for rainy days. Since fair days are usually of the former character, and those on which there is precipitation of the latter, what has been said of them is valid for our present topic.

SUMMARY. Based upon the observation of the teachers, the deportment of the pupils is at its best during cold, calm and clear weather—at its worst during that characterized as hot and muggy. The opinion is also that boys are affected more than girls.

As shown by the empirical study, school attendance—and we have argued that this is a measure of health—is at its best during the spring and autumn months, upon days of moderate temperature, when the barometrical readings are at neither extreme; when the humidity and wind are moderate and upon "Fair," dry days. Deportment is at its best during the winter months and at the beginning and end of the school year; when the temperature is either very low or very high; when the barometer is high; when the humidity is great; during condition of calm and upon cloudy, wet days.

CHAPTER VIII

CRIME AND THE WEATHER

The literature of criminology is full of scientific attempts to analyze the complex mental states which give rise to excesses in conduct. They have received a microscopic scrutiny; and the influence of social condition, of race trait, of physical health, and many other factors which affect the prevalence of crimes of various classes have been somewhat carefully determined. The effect of weather conditions as a phase of the cosmical environment has, however, for the most part, been overlooked. From the standpoint of climate and its general influence upon mental characteristics, the subject has been attacked, but the definite meteorological conditions, the innumerable combinations of which give us the ever-changing thing which we call weather, have hardly been scientifically considered in their causal relation to conduct.

In this chapter, I shall attempt to do so through a discussion of classes of data designated as V., VI. and VII. (page 64), considering the classes separately. The first of these, comprising roughly forty thousand cases of arrest for assault and battery (36,627 males, 3,134 females) is illustrated by Figures 12 to 19.

ASSAULT.[1] This class of data furnishes one of our best means for studying the emotional states affecting conduct, and conclusions drawn from it should be more valid than those for some of the other classes, since the judgment as to what constitutes a datum is invariable throughout the period of study and holds for every day of the year.

In the study for schools we found the teachers varying materially from one another in their criterion of judgment, and we also noted differences in the days of the school week which seemed due to accidental condition not acting here. The hand of the law, however, is always stern and the unfeeling policeman is probably more regularly severe than is the teacher.

There are, however, certain changes in mode of life brought about by the different seasons of the year which might, irrespective of the direct effects of meteorological conditions influence the monthly occurrence of this class of data, but these will be spoken of under the head, *"Occurrence."* Yet there is one accidental effect which might well be spoken of here. It is the increase of arrests for assaults upon holidays and occasions of unusual celebration in the city. Even political campaigns can be plainly determined from a study of the data alone, and the Christmas season deflects materially the occurrence curve. These accidental variations would tend to equalize each other's effects and to reduce the accidental error to a minimum; but when, as is occasionally the case, one of these exceptionally pugnacious days is one of unusual meteorological conditions—conditions oc-

[1]Wherever this term is used, it means the crime technically known as "Assault and Battery."

curring but a very few times during the period studied —such a correction does not occur.

As has before been explained, the heavy horizontal line upon the accompanying figures represents *expectancy,* and an excess or deficiency of arrests for any given meteorological condition by the distance of the curves above or below that line, each of the lighter horizontal lines representing twenty per cent.

The entire curves (————) are for males; the dotted curves (------------) for females.

OCCURRENCE, MALE—This curve, as can be seen by Figure 12, is most beautifully regular, showing a gradual increase from January, the coldest month, to July, the

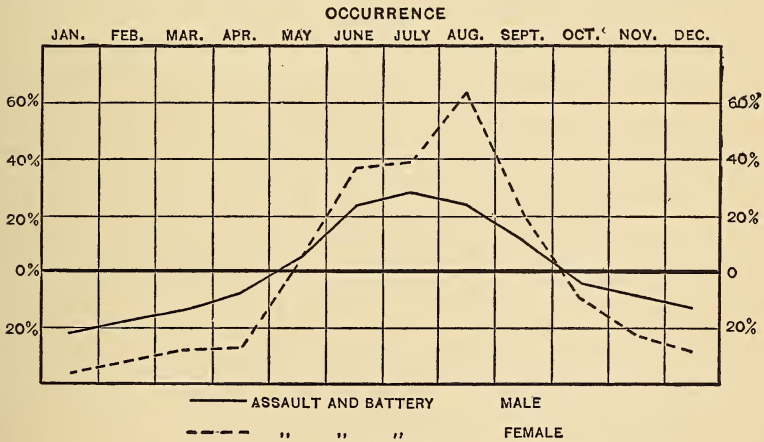


Figure 12

hottest month, and a decrease for the remainder of the year. In fact, it is very nearly identical with the curve of monthly means for temperature (see Fig. 1), and one must conclude that temperature, more than any other condition, affects the emotional states which are conducive to fighting. It is possible that the greater publicity of life practiced in the summer time, when most of the people of the poorer classes are in the streets to escape the torture of the stifling rooms, would tend to bring to the notice of the police, altercations which, under the conditions of life in the winter time would have escaped them. If so, the curve would be affected. It seems very probable, too, that opportunities for fistic encounters would be increased by summer customs, and this, too, prove a factor. However that may be, we cannot suppose any considerable part of the summer's excess and winter's deficiency due to these accidental causes, but for the most part to the weather conditions themselves.

The curve for females compares in a very interesting way with the preceding in that the excess for the summer months is much greater than for the males, with a correspondingly greater deficiency for the winter. This is but a suggestion of what most of the curves show where a comparison of the two sexes is made,—namely, a greater susceptibility of women to weather influence. The unusual excess for the month of August, so much greater than the preceding month, which is really the hotter of the two, would seem to imply that there is a point in the endurance of heat at which "forbearance ceases to be a virtue," and after the months of June and July had been borne with some equanimity, the heat of August proved too much and its effects were noted in the police court. In a paper by S. A. Hill[1] some interesting statements are made bearing upon prevalence of crimes due to irritability of temper in India, and although the study is for both sexes, I mention it here.

[1] "Effects of the weather upon Death Rate and Crime in India." *Nature*, Vol. 29, p. 338.

He has classed under this head both murder and suicide, explaining that the latter is in India, as a rule, not the result of fixed melancholia, three-fourths of the cases being those of young married women, who, finding life unbearable under the daily and hourly sting of the mother-in-law's tongue, end it at last by jumping down a well.

The average number of deaths from each of those causes, for each month, taken from a study of the sanitary commissioner's tables for several years, he gives as follows:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Suicide	105	109	196	268	246	248	246	242	269	250	151	100
Murder	105	94	105	119	125	128	132	154	145	135	115	98

In commenting upon this, he says: "Both series present a distinct annual variation, notwithstanding some irregularities which would probably disappear if we had larger numbers to deal with, and in both the phases are similar, the minimum being reached in the middle of cold weather and the maximum in the hot season and rains." And again, with regard to an arithmetical equation given: "And any one who has been in India during the cold weather, and seen to what an abject condition the ordinary native is reduced by a temperature of 60° or so, can believe that there is some truth in the results above given, that at about 48° curves of violence would cease, for at such a temperature nobody would possess a sufficient store of energy to enable him to commit a crime of any more grave description than petit larceny."

Temperature. Figure 13 shows unmistakably that except for the very highest temperatures, the number of assaults increases with the heat. That is what Shakespeare had noticed, and the data corroborate in a striking manner the wonderful observational powers of the great master. The minor fluctuations of the curves may be disregarded, as they are very probably due to accidents, but the general showing is one of marked deficiency for low temperature with a somewhat gradual increase to its

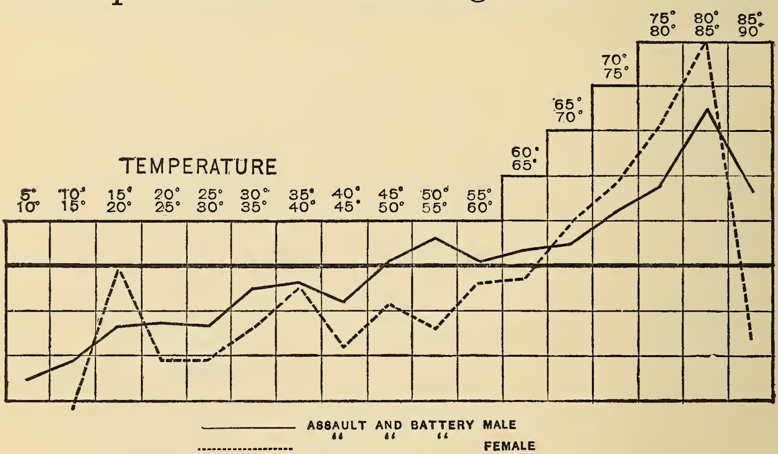


Figure 13

maximum excess in the 80°-85° group, at which point a sudden drop takes place. This final decrease is in itself interesting. It seems without doubt to be due to the devitalizing effect of the intense heat of 85° and above. This has been corroborated by the study of the death rate, which is found to increase wonderfully for such temperatures.

For fighting purposes, one must have not only the inclination, but also the energy to support his position *vi et armis.* Heat of any considerable intensity seems productive of emotional states, furnishing the former, (*i. e.*, inclination) but at a certain point the latter is de-

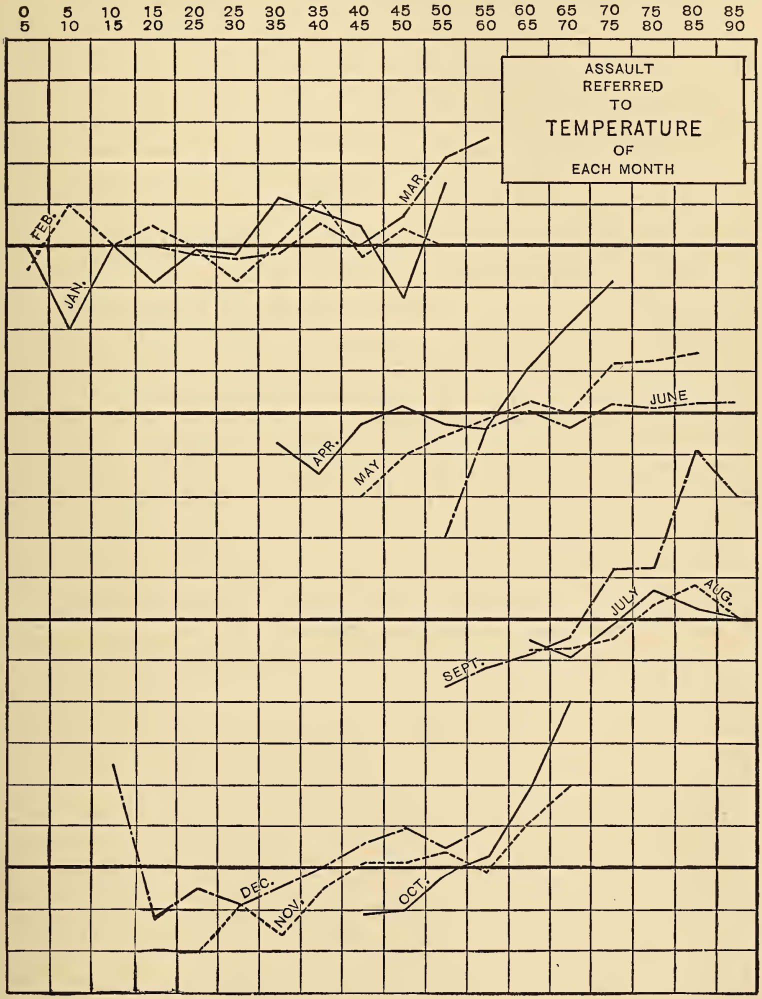


Figure 14

pleted by extra demands made upon it by the processes of life under such conditions, and without it, the consciousness of sufficient strength to down an antagonist is wanting. If our data showed simple instability of temper—or even profanity—the results might be different; but an inclination to fight, without the energy to back it up, gets nobody into the police court.

In the course of this study of temperature, it seemed probable that from the very nature of the curves shown, there might be conditions of heat which would fail to show, even though their efforts be considerable. Such would be unseasonable heat; that is, excessively hot days *for the time of year,* though in actual temperature only equal to comparatively cool ones for a hotter season. For example, an April day of a mean temperature of 75°, which would be unusual for that month, might, for all this curve shows, have a disastrous effect upon conduct; yet in the study of that condition for the year, the fact be entirely concealed by the soothing effect of an August day of same temperature. In order to discover such negation of results, temperature curves were constructed for each month of the year, and are shown by Figure 14. Although this figure is not elsewhere explained, it is constructed in every respect upon the same principles as the others, and shows some exceedingly interesting things, especially when studied in connection with Figure 33, the only other showing monthly temperature curves. The curves interpreted show that in January and February the temperature variations have very little effect—that is, the curves have no very marked general tendency either up or down, the fluctuations being probably due to accidental conditions which a larger number of data would tend to disappear. In March the hot days are beginning to have their effect, which in April is at its maximum, decreasing as the heat of summer comes on, and increasing again, till an autumnal climax is reached in October, with another diminuendo effect for hot days as winter approaches. The unusual and interesting fact demonstrated here with a certainty that cannot be doubted, is that the unseasonably hot days of spring and autumn are the pugnacious ones, even though the actual heat be much less than that for summer. In fact, it will be noticed that for the excessively hot days, registering a mean of from 80° to 90°, the number of assaults for at least three of the months upon which that condition is reached (July, August and September) decreases. We might infer from this that conditions of heat up to a certain limit are vitalizing in their tendency, while at the same time irritating, especially when we are not dressed in accordance with the demands of comfort; but above that limit, heat is as devitalizing in its effect as to leave hardly energy enough to carry on a fight. This is but a corroboration of the effects of great heat shown by the temperature curves for the year.

A comparison of these curves for males and females would seem to show that the latter are more affected by heat than the former. For almost all the groups, the deficiency or excess shown for males is intensified in that for females. This is especially shown in the excess for the 80°-85° group, and the drop at the end. Although for the highest temperature shown, few men were left with energy enough to quarrel, it would seem that the fighting blood was entirely drawn from the veins of the other sex.

Barometer. Periods of low barometer are proved by our curves to be the harvest season for the bluecoats. These curves (Fig. 15) show even a greater regularity of trend than do those which we have just considered, though their tendency is in the other direction. They are, too, somewhat more difficult to interpret. It does not seem probable that the actual weight of the atmosphere itself is the direct cause of the results shown, but the barometrical conditions as accompaniments of other meteorological states; perhaps their relation to storms. The entire variation of the mercury column for New

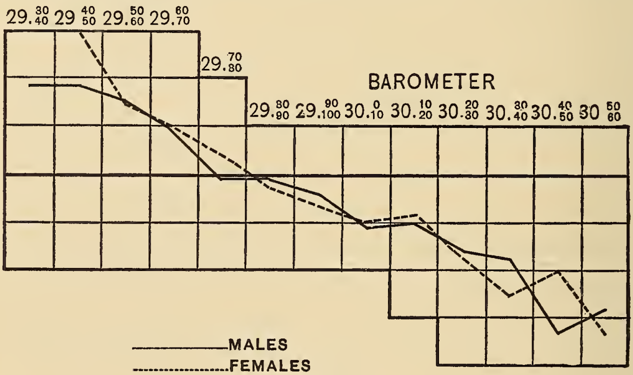


Figure 15

York is but little more than an inch, while one experiences a drop of five inches in going to Denver, Colo., and five more in crossing the Rocky Mountains by almost any route, without experiencing any marked emotional change, so the density itself cannot be the cause. Low barometers are common to storms, but the excess in assaults did not occur at such times, as will be shown under our study of character of the day and precipitation. The same barometrical conditions frequently immediately precede storms—in fact, are a part of their meteorological preliminaries—and here we perhaps have a key to the problem. Many people "feel" a storm coming. Signals, both mental and physiological, more trustworthy even than the black flag of the Weather Bureau, tell them of its approach. If the emotional effects of such conditions be what seem to be indicated by our curves, we would do well at such a signal of storm not only to keep our shipping in port, but keep away from our enemies, especially if they are better fighters than ourselves. But little difference is shown here between the effects upon the two sexes.

HUMIDITY. The effects of varying humidities as shown by our curves (Fig. 16) are, I believe, contrary to what is ordinarily thought to be the case. We find excesses of assaults for low readings and deficiencies for high ones. When we consider that muggy, sticky days —the kinds that we all detest—are of the latter class, we are almost inclined to doubt the correctness of these

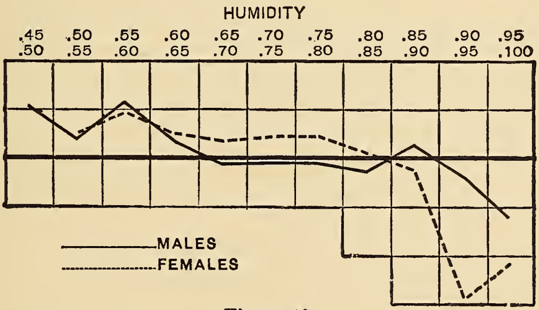


Figure 16

results. Nevertheless, based upon 40,000 data, they must be taken as somewhat conclusive. The reason is undoubtedly this. Days of high humidity are not only emotionally but vitally depressing, and we have the same element entering into our problem that we had in the discussion of excessively high temperatures. On such days we perhaps feel like fighting, but such a thing is altogether too much exertion, and the police records are none the wiser. For low humidities, energy is at a surplus; and although the emotional state is ordinarily much more positive, it would seem as if, in the long run, with plenty of strength at command, an opportunity to use it is generally to be found; in fact, that surplus energy is a more dangerous thing to have about than the most pugnacious inclination with nothing to back it up.

The curve for females, with its marked drop for humidities above 90°, shows this to be especially true.

Wind. Whatever may be our dislike for March hurricanes, the police judge does not profit by them. Our curves (Fig. 17) show that the mild winds of between 150 and 200 miles per day (40 per cent. of the days of

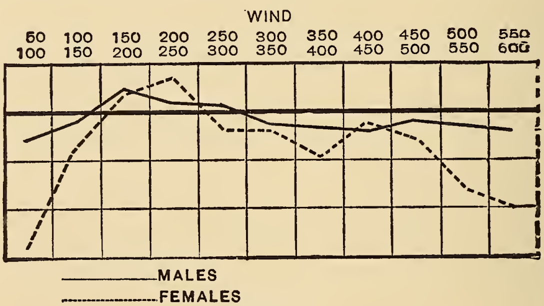


Figure 17

the year have such) are the pugnacious ones. At first thought this would be hard to account for, but some recent studies in England have made at least the deficiency for virtual calms explainable on the same basis as intense heat and high humidity.

Dr. J. B. Cohen (see Smithsonian Report, 1895) has shown that the atmosphere in large towns at certain times contains more than five times as much carbon dioxide as that of the surrounding country at the same time. He does not give the meteorological conditions of the days upon which the excess was greatest, but it is, I believe, reasonable to presume that they were without wind. Certainly upon windy days, there would be sufficient ventilation to prevent any such discrepancy.

Now an excess of carbon dioxide in the atmosphere can be produced only at the expense of oxygen. But oxygen is necessary to all the vital processes productive of energy in the animal kingdom, while carbon dioxide is equally baneful; hence, in great cities, during calms, energy must be deficient. The increase in death rate (see Chap. X.) is conclusive proof of this. But since vitality is essential to such crimes as assault, they, too, must fall below expectancy. The deficiency for high winds, I shall not attempt to account for. The curve for females shows the same intensifying of effects that we have noted for the others.

Character of the Day. Days, it will be remembered, are characterized at the Weather Bureau as "Fair," if for three-tenths or less of the hours from sunrise to sunset the sun is obscured, as "Partly Cloudy" if four, five, six or seven-tenths are obscured; if more, as "Cloudy." It has no reference to precipitation. Strange as it may seem, the cloudy days are the freest from personal encounter which has attracted the police. This may be partly due to the fact that not so many people are upon the streets, but in the other chapters, deportment in public schools and peni-

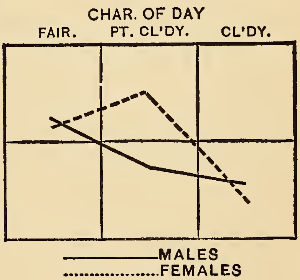


Figure 18

tentiary and asylums for the insane, suicide, and the death rate, all except the last, have shown the greatest deficiency for cloudy days. This seems explosive of many of our well founded beliefs. If it be true, fiction must choose fair days for its tragic climaxes, relegating its quieter movements to the cloudy.

Our thesis of reserve energy is applicable to an hypothesis for this curve.

The cloudy days are not the vitalizing ones, but the reverse.

PRECIPITATION. This curve (Fig. 19) is exactly what we should expect from the last, showing, as it does, a deficiency of assaults for wet days, however much it may contradict our general opinions upon the subject. The relation between the two sexes coincides with what has been shown upon the other charts.

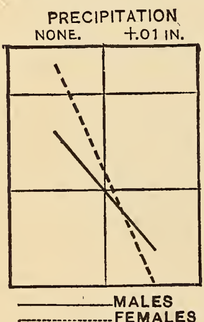


Figure 19

The deficiency of crime for rainy days is perhaps surprising, when we consider the excuse for being "out of sorts" which the disappointments attending stormy weather make legitimate; but we must conclude that ability is a more important factor than inclination, and that the problem of offensive crime is largely one of vital surplus.

Turning now to the other class of data which can be legitimately considered under the head of crime—murders for the city of Denver, Colo. (Class VI., see page 64)—we are forced to admit that the number of data is hardly great enough to form the basis of entirely valid conclusions, yet they are perhaps of interest, coming as they do from a general climate so different from that of

New York City. No figures are shown in illustration of these data.

Occurrence. The monthly distribution of this form of crime was found to resemble in general that of assault and battery, *i. e.*, a deficiency for the coldest months and an excess for the hottest, yet differing in that the greatest excesses for the year occurred in March (11%) and September (7%).

To one who has lived in Colorado, this fact does not seem strange, at least for the former month, since that is, by all odds, the most uncomfortable and unenjoyable month of the year and one during which a person would seem to have an excuse for being ugly and out of sorts, if at any period. The wind is at that time at an average velocity nearly double that of some other months, and the wind, as will be shown later, is the peculiarly provoking element in the dry regions of high altitude. These conditions do not, however, exist during the month of September, and it is not easy to account for the excess of crime for that month.

Temperature. Great heat seems to have precisely the same effect upon the homicidal tendency that has been shown for pugnacity earlier in this chapter. At temperatures below 70° a deficiency is shown, beginning with 60 per cent. for 15°, the lowest group studied, the curve gradually rising till an excess of 80 per cent. is reached at a mean temperature of 90°. The conditions so nearly resemble those for New York City to need no further comment.

Barometer. The same is practically true for barometrical conditions. Since the normal height of the mercury column is five inches less for Denver than for the sea level, some marked peculiarity of effect might be expected, but none is discoverable. The excess of murders is for low pressures and the deficiency for high, a total difference of 35 per cent. being shown in the occurrence.

Humidity. It is in this meteorological condition and the next to be discussed that the peculiar effects of the Colorado climates are most forcibly shown. In the case of humidity, the effect is that of the sea level tremendously exaggerated. Whereas, for New York City, low humidities are shown to be slightly provocative of brawls (an excess of 20 per cent. or so) the crackling, dry Colorado day, which one who has ever experienced can never forget, with a mean humidity of from 10° to 15°, sends the crime up to an excess of 400, which means that for the thirteen years covered by the study, murders were four times as prevalent as under ordinary conditions. In fact, one might almost fear to go upon the streets on such a day. We of lower altitudes may consider ourselves lucky that such extremes of dryness are only reached upon the arid plains of the mountain regions.

It seems certain that the direct influence of the condition is through the increased potential of atmospheric electricity which always accompanies it (see page 132). As has already been shown, dry air, especially if it be in motion through the wind, is productive of electrical states which influence to a marked degree both the emotional states and the bodily energy necessary for action, and in some way, which in the present stage of investigation cannot be explained, the result is disastrous to seemly behavior.

Wind. High winds for the Colorado altitudes parallel in their effects the conditions of low humidity as just shown. In fact, as the two conditions frequently accompany one another, it is difficult to isolate the influence of each, and it is possible that the one without the other would be comparatively harmless. The fact is, however, that for days upon which the total movement of the wind was less than 200 miles for the day, murders, for the city of Denver, were found to be below the normal in prevalence. From that point, the increase was very rapid, reaching an excess of more than 400 per cent. (four times) for movements of 400 miles per day. This is certainly an effect peculiar to the dry winds of the region, since reference to Figure 17 shows that for winds of the same velocity in New York City—and they are much more frequently experienced there than in Denver—the effects are quieting rather than disturbing to the spirits. Again we must refer their deadly effect upon the western plains to the super-induced electrical potential of the atmosphere which increases (see page 126) with the wind.

Character of the Day and Precipitation. The seeming effects of the meteorological conditions already discussed in this chapter have either been very similar for Denver and New York City (occurrence, temperature and barometer), or qualitatively the same though different in magnitude.

In the effects of cloudy and wet days we have diametrical opposites for the two cities. At the sea level we find disorder most prevalent upon dry, clear (or at least partly clear) days; in the altitude, upon wet, cloudy ones; conditions which are in opposition to the hypothesis of vital energy which I shall propose in the concluding chapter. For Denver, murders showed an excess of 25 per cent. upon "cloudy" days, and are of only a little less upon those having some precipitation. The effect must be, it seems to me, entirely upon the emotions, producing a mental state of great instability and consequent liability to dangerous impulsive acts. Where cloudy days are of common occurrence, as in the East, one might, perhaps—in spite of the sentiments expressed on page 84—learn to control one's self during their prevalence, but with their rare occurrence, as in Colorado, the effect is perhaps overpowering. At least, such seems to be the case. I cannot believe that they are energy producing in their effect, and since I have argued that conscious strength as well as an inclination, is a prerequisite to an active encounter, should on *a priori* grounds argue that their effect should not be what we find for Denver. It is, however, what we find, and not what we seemingly should find that we are setting forth.

The third class of data, having to do with the deportment of the inmates of the New York City Penitentiary on Randall's Island, differs from the other two discussed in this chapter in that it covers the activities of the criminal rather than criminal acts of persons who perhaps have been, hitherto, law-abiding citizens. The problem of discipline in institutions where large numbers of men having no very high respect for law and order are confined, is a difficult one and various means are under use for its preservation. Among them is the plan of isolating for various lengths of time within dark cells the perpetrators of especially flagrant misdemeanors. This incarceration in itself entails sufficient discomfort to make it a thing to be abhorred by the criminal for immediate physical causes; but it is strenuously avoided for another, and perhaps a more potent reason that the punishment carries with it an extension of sentence, or at least an annulment of any time rebate which might otherwise be awarded. For these reasons dark room punishment—and it is this that I have taken as the basis of study—is not a common form of discipline, though one which certainly is indicative of a grave breach of prison propriety and a valid datum of bad conduct. The nearly four thousand such data (class VII., page 64) were taken from the record books of the Randall's Island institution covering the years 1891-1897 inclusive. A considerably larger number of such punishments had been imposed during those years, for some of which it was impossible to determine from the records the exact day upon which the punishable misdemeanors had been committed. Such were not included in this study, since it is the relation between weather states and the deportment of the criminal—not the action of the warden—that it deals with.

Correspondence with prison officials in various parts of the country, although productive of no definite statements of any value, gave evidence that the question of weather influences had been considered in a general way by many. One superintendent of a State Reformatory of more than national repute, says: "Ourselves, in common with all observing persons having charge of considerable numbers of human beings grouped together in close contact, observe always changed moods of the mass which seem to be attributable to different seasons and climatic causes, but there are no facts scientific, registered and available for the replies you desire."

Another, after explaining a similar inability to make definite statements, writes: "At the same time, I have no doubt that the weather has a certain influence upon different temperaments."

A prison warden writes as follows: "I have noticed during the four years I have been warden of this prison that we would seem to have epidemics of infractions of prison rules—more particularly that of fighting. When these have occurred I have often said that we must be having high winds or some condition of the atmosphere particularly rasping. I think that is everyone's experience."

Occurrence. An inspection of the curve (not shown) which expresses the monthly distribution of dark-room tenants shows a considerable excess for January (15%) and the earlier months of the year, a deficiency for May, June and July, an excess again for August, and a deficiency for the remaining months of the year. On the whole the number of breaches of discipline seems to have an inverse relation to the general freedom of activity and exercise which the different seasons of the year make possible in a corrective institution. For the first few months of the year the weather is such as to prevent outdoor exercise, and a consequent increase in active disorder is noticeable. With the advent of the warmer months, greater freedom is possible and the dark room is comparatively free from occupants. August, however, with an excess of 10 per cent. of misdemeanors, is in direct opposition to this hypothesis and its effect must be accounted for in some other way. It seems to me possible that two factors must be considered in doing so—first, the excessive heat of the month, which will be shown in the next paragraph to have a peculiarly exasperating effect upon the penitentiary inmate, and second, the fact that the freedom of the summer time has, so far as its quieting influence is concerned, worn itself out. The contrast of this freedom, with the close confinement of the winter months was sufficient, perhaps, to account in part for the good behavior during the early summer, but not to counteract the effects of long continued heat. It is possible that contrast of conditions is also the explanation of the deficiency of misdemeanors for the late autumn and early winter, though this time it is the contrast between the heat of August and the delightful coolness of the later year, producing a quieting effect sufficient to compensate even for the adverse influences of greater physical restraint.

TEMPERATURE. The curve upon

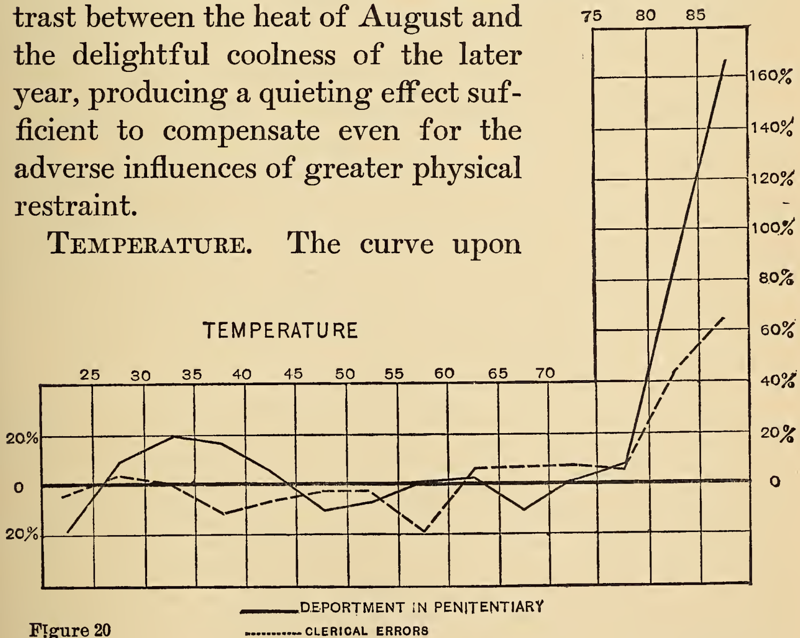


Figure 20

Figure 20, which shows the seeming influence of varying degrees of temperature upon the deportment of the penitentiary inmates, is in every respect comparable with that for monthly occurrence, and is particularly interesting because of the light which it throws upon the question of hot weather influence. The deficiency of disorder for the lowest temperature group is what might be expected from the meagreness of the data for the coldest months, and the curve as a whole is not at all startling until we reach the part for 75° and above. Here we find an effect far greater than any which is shown for other classes of

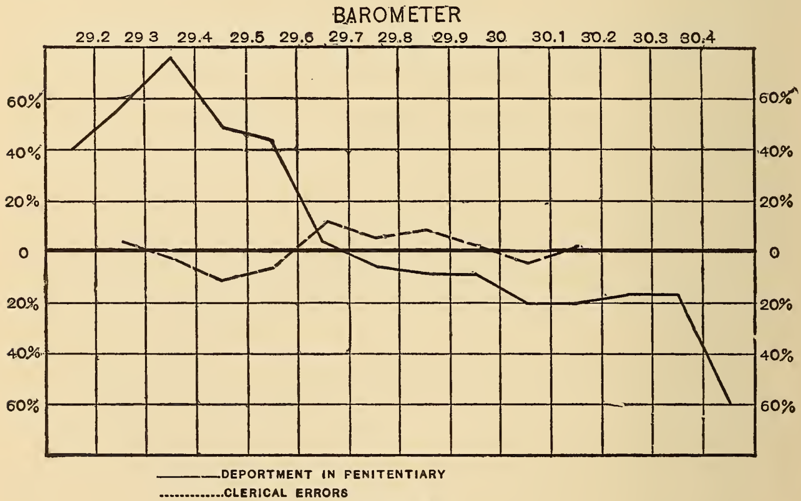


Figure 21

persons, either male or female, adults or children, and judging from the other studies, one altogether out of proportion to what it should be. This being the case, it is fair to ask if there is not something in the enforced condition of the convict which is provocative of such results, and if found, to ask if that thing is not capable of correction. The persons studied in each of the other chapters, with the exception of the school children, are at large and free to choose their own location for combating the heat. They are left free choice, also, so far as the pocketbook allows, in the matter of clothing. Neither of these facts is, however, true for the convict, nor can be in the nature of the case. But with the school children, who are also determined as to choice of location, we find the high temperature, as recorded by the weather bureau, particularly soothing, and ascribed the fact to the coolness of the school room. Finding the reverse conditions of deportment true for the convict, we are willing to hypothecate that the prison is excessively hot and that the effects which we find are due to an unnatural and perhaps unnecessarily stifling atmosphere there. The only other uniform element of difference between the convict and the subjects of study in the other chapters is that of clothing. It may be,—though I cannot speak with au-

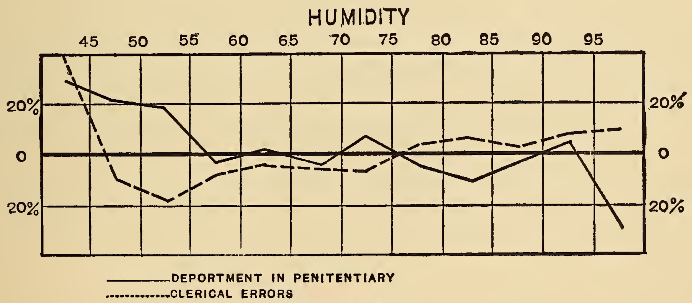


Figure 22

thority in the matter, for I never studied a prison except for the few days while securing these data, and they were in cold weather,—that the prison garb is not well chosen for withstanding the heat of summer, and that its wearer is subjected to a real hardship if not to injury through its use. A day in a dark room is, perhaps, nothing serious in itself, but the breach of discipline which places one there may mean much, and if the frequency of such breach is a measure of the general emotional equilibrium of the convict body, the whole problem of prison discipline might well include a study of such seemingly remote elements as the temperature of buildings and the prison garb. I may be reading too much into my curve, but this seems to me to be suggested by it.

BAROMETER. Varying degrees of atmospheric pressure, in their influence upon active disorder are typically exemplified by the curve for barometrical readings (Fig. 21); it varies but little from the others of its class, and I can say nothing regarding it which has not been said for the others.

The same may also be said for the curves upon Fig-

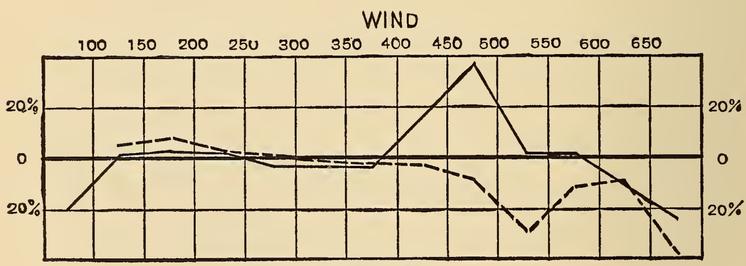


Figure 23

ures 22 and 23, based upon conditions of humidity and wind. They are nearly identical with those, showing the influence of the same weather states upon the conduct of the pupils in the public schools, and what was there said applies equally well at this point.

CHARACTER OF THE DAY AND PRECIPITATION. The figures bearing upon these meteorological conditions show

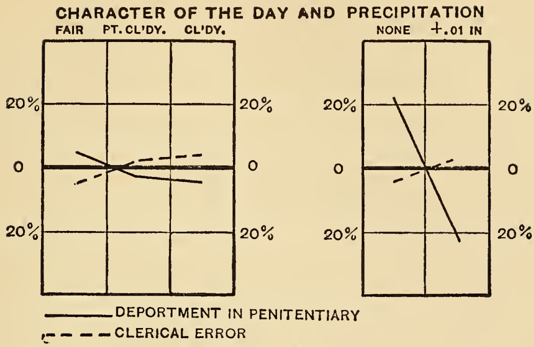


Figure 24

plainly enough that the clear, dry days are the troublesome ones, the excess of misconduct for the former being 6 per cent. and for the latter, 20 per cent., with a deficiency for all the remaining characteristics of weather which are, by common consent, more agreeable. Even though prepared for such a showing by statements in the preceding chapter, it seems difficult to believe, and is explainable only, it seems to me, upon the theory of our uses of vital energy under such conditions. But this has already been touched upon.

CHAPTER IX

INSANITY AND THE WEATHER

In the very imperfect and incomplete study which I have been able to make of the insane with reference to meteorological condition, I have been somewhat surprised to find that weather effects do not seem to be so marked with them as with normal persons. The reverse, it seemed to me, might be expected, since among the latter it is, generally speaking, the neurotic, unstable mind, rather than the stolid, phlegmatic type that is affected most, and with the insane we have the theoretically susceptible type in its extreme form. Correspondence with superintendents of asylums in various parts of the country, however, shows that as a class, those officers are much more skeptical of weather influences than are the school teachers; in several cases asserting that nothing had been observed which would lead to the belief that weather states exert any influence whatever. To officers in charge of some twenty asylums for the insane, the same questionaire was sent (see page 94) that was used with the teachers. Returns were made in full, covering some three thousand patients; others who were appealed to either failed to reply, or wrote general letters, some of which are quoted from below. Of those who made definite replies, the opinion was unanimous that the deportment of their charges was at its best during "clear" weather, while "cold" and "calm" were also mentioned as conducive to good behavior. There was also unanimity of opinion that "stormy" or "muggy" weather was productive of the opposite extreme of deportment, with "cloudy" and "hot" days as close seconds. But one reply covered the question of mechanical productivity and in that case, "least" and "most" seemed to be affected as was good and bad deportment. It is interesting to note how widely these opinions differ from the results of the empirical study stated later in this chapter.

The general discussions of the questionaire, which were very generously given even though no definite answers were made to the questions, were interesting and to the point, and I quote from them somewhat fully. One superintendent replies: "I have noticed this much, that when there is unpleasant weather and the patients are obliged to stay in a long time and cannot get out to exercise in work or other ways as freely as they can in pleasant weather, that under these conditions they are apt to be a little restless and more active. I cannot see that the weather plays any very great part in their mental activity."

Another, more skeptical of any weather influence, writes: "Your note of December 15 is at hand. In reference to your questionaire in regard to the possible relationship between mental states and meteorological conditions, I have to say that nothing in my experience will furnish any material in this direction. In fact, like the famous chapter on snakes in Ireland, I have little faith in there being any particular connection between the state of the weather and mental states."

A third, with a little more faith and definiteness of statement, replies: "Your note came to me at a very busy time, the close of the quarter and the close of the year. With a house of 1,030 insane persons, with the needed number of attendants, I have very little time to give to outside matters and no one in the house who has time to give to such an investigation as you propose, for with the class of patients we now have, it takes all their time and attention to keep their work in proper order. I may state as a general fact that all the patients are more or less affected by the changes of the weather and a succession of rainy days, dull and gloomy, makes all more or less fretful and irritable, more so, in fact, than usual; and when the weather changes to clear and bright a corresponding change can be noticed, and between the extremes will be found all varieties of temper, disposition and fretfulness."

Still another, expressing the opinion stated earlier in this chapter as the result of my study, says: "I have not found that the insane are so much influenced by extreme changes in the weather as are the sane, for the reason that their general sensibility is obtunded. They are, however, depressed by hot, muggy weather, and stimulated by dry, clear, and either cold or temperate weather. Comparing the patients with the employees, the latter are most affected physically and least mentally by weather changes."

These letters express in a general way the sentiments of all who replied to my queries, and may be taken as representing the opinion of experts on the question of weather influences upon the insane. At the outset of my study I hoped to secure definite records of discipline or restraint for some of the large asylums in the vicinity of New York City, and use them in the same manner as those for the deportment in the public schools. My attempt to secure such data was, however, unsuccessful. Records were placed at my disposal for an asylum in a distant part of the country, but since no statistics of the U. S. Weather Bureau were sufficiently near to furnish valid meteorological data, they could not be utilized. As the only other source of information, bearing on the behavior of the insane, I have used that portion of the police records for New York City covering arrests for insanity (class VIII., page 65). Except for the fewness of the data there available, the record furnishes better material for our study than could any asylum register, since each datum covers an occasion when a supposedly sane person became insane; if not that, an occasion when a person, sufficiently sane to be at large and without restraint, became dangerously unbalanced mentally. The study is then one of those meteorological conditions most tending to throw a person, probably already predisposed to insanity, over the border line which, in the eye of the law, separates the mentally balanced from the mentally unbalanced.

Occurrence. We find between the curves upon Figure 25, which show the occurrence of arrests for insanity during the months of the year, and those for suicide (Figure 38), a striking semblance; the same deficiencies for the cold months of the year, with the greatest excesses for the late spring and early summer. There is, however, a marked difference between the two, in that for suicide, the excesses continue throughout the heated period of the year, while for insanity there is a considerable decrease for males, and an actual deficiency for females at that time.

If, as we might suppose, there is a similarity in the mental conditions productive both of insanity and suicide, and some have argued that the latter is always an indication of the former, we have here a difference in its expression, since the hottest months are productive of an excess of self-destruction though not of insanity. I shall, however, argue that suicides are of two classes: those who make an end of themselves for no fully recognized reason, the influence being undefined though fully

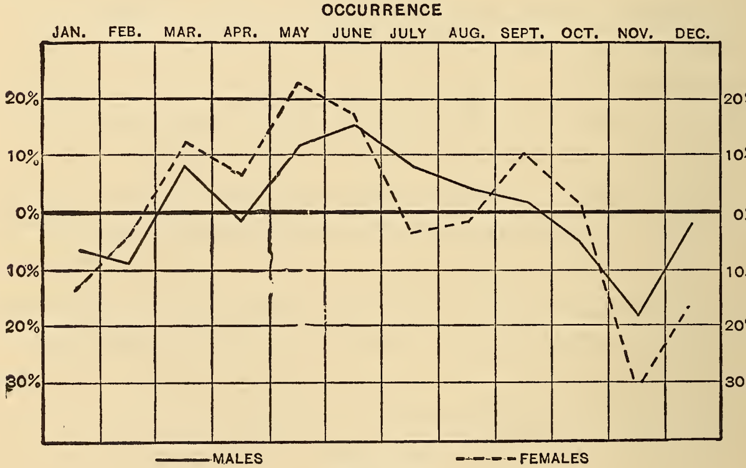


Figure 25

potent (Strahan's "True suicide"); such a one is impelled to the act by an impulse which he finds irresistible and not because he may escape evil or gain something more desirable; and second ("Rational suicide"), those who recognize conditions as unendurable and calmly decide, after full consideration, to take their own lives. The second class, it seems to me, have little in common mentally with the insane person, and it would also seem, upon consideration of the occurrence curves of the two classes, that it is this second class of suicides that contributes largely to our data for the hottest months. We have all, perhaps, experienced days so hot as to wonder whether life were really worth the living, and if there had not been other strong inducements for its continuation, might have decided adversely. With the insane we can not suppose that this rational side of the problem enters at all. No one ever became a maniac because, all things considered, he thought it most conducive to his happiness. Seemingly, hot weather could affect them only as it affects suicides of the first class considered, and our curve would seem to place this class and the insane in the same general group. Since the extreme variations of the curve for females is greater than for males, we must conclude that the weather influences the former to a greater extent than the latter. The excess of women who were taken to the asylum during the month of September is hard to account for and may be an accidental fluctuation due to the fewness of data.

Temperature. For the greater part of the temperature curve (Fig. 26) the number of insane as considered by our study raises but little from expectancy; so little as to lead us to believe that the influence of that meteorological condition is but slight, upon the mentally unbalanced. At the extremes of heat and cold there is, however, an unmistakable effect, the result of each being an excess of mental disturbance. This is undoubtedly due to the direct physical stress of those conditions. Extreme suffering of any kind, as is well known, produces that result, and many cases are on record of arctic explorers and sailors becoming insane through exposure, as well as of well authenticated cases of heat insanity.

It is possible that some cases of simple sunstroke were entered in the police registers as insanity, which, if true, would tend to increase the number of data inordinately for the highest temperature groups. The same relation

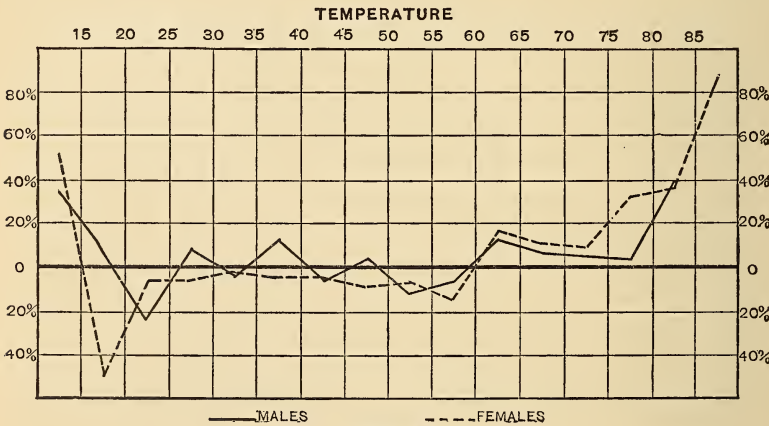


Figure 26

is here shown between the two sexes that has been commented upon in other chapters; namely, the greater susceptibility of females to weather influences.

Barometer. In the light of other figures in this volume, there is nothing peculiar or characteristic in Figure 27 which shows the seeming influence of different degrees of atmospheric pressure upon those predisposed to insanity. The influence seems to be almost identical with that upon the prevalence of suicide and differs but slightly from that upon deportment in the public schools and the penitentiary. The tendency to street brawls, too, seems to be the same, and whatever has been said in the discussion of any of those classes of data, so far as

I know might be repeated here. The greater susceptibility of females to weather influences is also indicated.

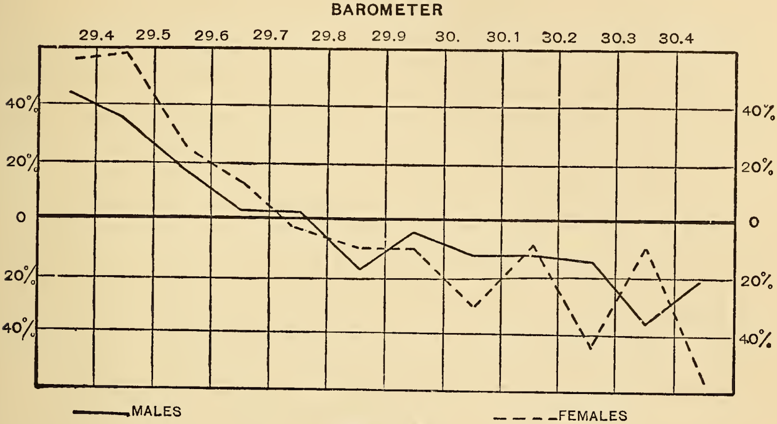


Figure 27

HUMIDITY. No particular comment is needed either in the light of what has already been said concerning the influence of humidity upon mental states, shown upon Figure 28. From its similarity to the others for the same meteorological condition, we should argue that those peculiarities which are productive of minor abnormalities of conduct among the sane, are conducive to those excesses of conduct which constitute insanity. It is noticeable, however, that effects of varying degrees of atmospheric moisture, as I have discovered them, do not at all correspond with the opinions as expressed in the letters from asylum officials, who invariably placed "muggy" days as among those most disastrous to mental composure. The term muggy ordinarily carries with it the idea of moisture; in fact, translated into the nomenclature of the meteorologist would mean "great humidity," and if the observations of the experts were correct, we should expect to find our data excessive under those conditions. That the case is exactly the reverse is shown by our figure. This same discrepancy of opinion was noted for the school teachers. I can account for it in no other way than that in the process of introspection which must accompany any attempt to remember our

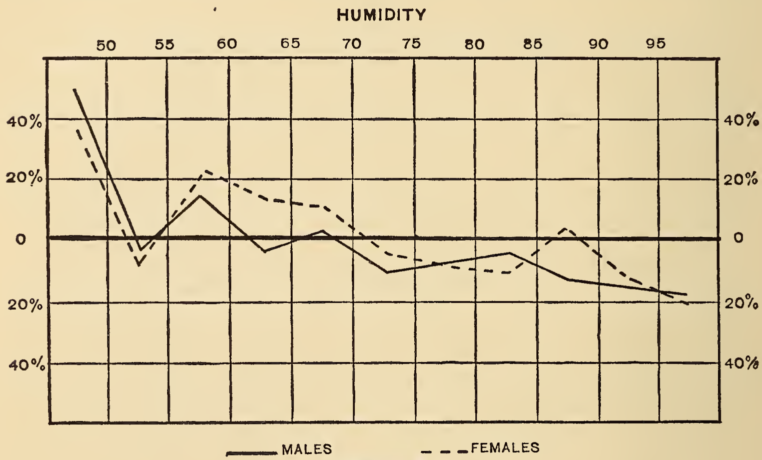


Figure 28

past experiences, we are influenced by the feeling of physical discomfiture which is associated with the muggy day, and that our judgment is influenced accordingly.

WIND. Varying movements of the atmosphere seem to have but slight influence upon the insane (Fig. 29). Except for the marked deficiency of indications of mental unbalance for periods of calm, we find none in excess of the "probable error" mathematically computed, for the data are so few for the groups from 250 to 700 miles total movement for the day as to make the fluctuations of our curve for those groups, meaningless. In the effects of calm days, the official opinions are entirely corroborative of our results. The general influence of such days is, however, fully discussed in Chapter XIV.

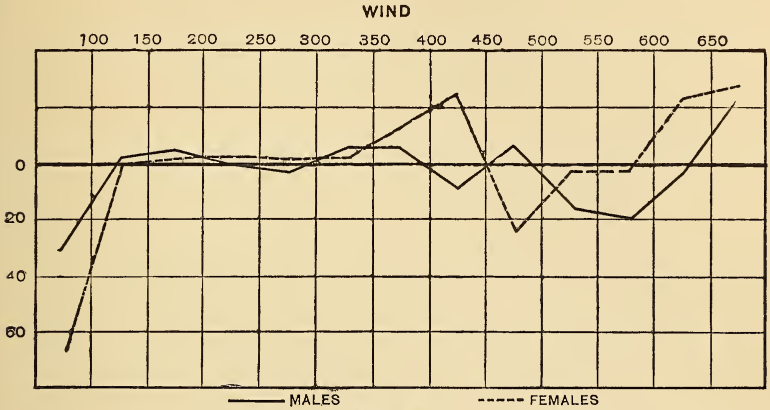


Figure 29

CHARACTER OF THE DAY AND PRECIPITATION. In the influence of these conditions we are again at variance with expert opinion. The latter gave us stormy days as disastrous in their effect upon discipline, while during such days I find that upon the street, evidences of insanity were much less prevalent than usual. It is true that in the hospitals, the patients are under an equal scrutiny during all kinds of weather, while it is possible that on stormy and wet days those who are predisposed to mental ailments are to some extent kept within doors, out of the eye of the guardian of the peace, but it is also true that in many cases the police were called to homes for the purpose of removing the unfortunate subjects of our study to the hospital; a fact which would in part, at least, compensate for this difference. Figure 30 shows that fully thirty per cent. more arrests were made upon days when there was no precipitation than when there was some—nearly one-third as many more—and it seems hardly probable that this difference is due entirely to lack of publicity under the latter conditions. I

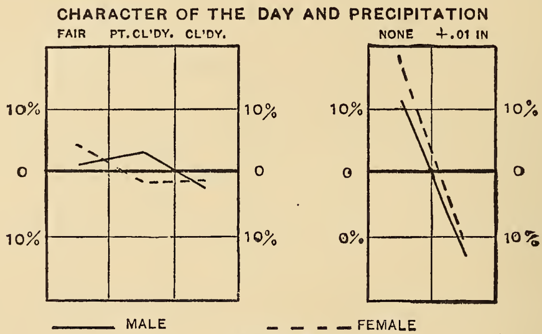


Figure 30

can ascribe it only to the devitalizing influence which is discussed more fully in the concluding chapter.

That this chapter is entirely incommensurate with the importance of the subject, I am aware, but I hope at some later time to supply certain of its defects, through the study of a larger number of data.

Summary. Arrests for insanity are below the normal in prevalence during the colder months of the year, and above the normal for the warmer, though not the hottest months; are affected but slightly by different degrees of temperature, except by the very hottest, which produce a marked increase; are excessive for low, and deficient for high barometrical conditions; are more prevalent for periods of low humidity than for high; are deficient for calms, with little effect from higher wind velocities; are slightly above the normal for "Fair," and considerably above for "Dry" days.

CHAPTER X

HEALTH AND THE WEATHER

The whole question of climatology has been fully exploited by the medical profession, and a considerable number of volumes, beside magazine articles almost innumerable, are in print upon the subject. In the library of the Surgeon-General at Washington are several thousand titles under the heads: "climate," "meteorology," etc. These do not, however, with a few comparatively important exceptions, in any way touch upon the question of weather influences as I have attempted to do so in the previous chapters of this book. In fact, so far as I know, such has never been done scientifically.

There are probably few physicians in practice who have not observed again and again, and commented upon the seeming effects of peculiar weather states upon their patients, for such effects are too obvious in many cases to be overlooked. They are, perhaps, reckoned with in the treatment prescribed, and it is possible that some practitioners have even formulated rules based upon their own weather observations, which guide them in certain matters of practice. If such be the case, however, they seem never to have put their conclusions in print for the benefit of others. If the weather does in any marked way affect the sick it is of much importance that we know it and that the physician make allowance for such an influence. The school teacher, the policeman and the prison warden can do so only through a modification of the rules of discipline, with perhaps a sharper eye for evil doers at some times than at others as the weather conditions seem to suggest. With the physicians the possibilities are of quite a different order, for if a certain meteorological condition is found to produce upon people in general a definite and well determined effect, a temporary change of treatment may be made to counteract that effect and undesirable results be obviated. Perhaps it will never be possible to determine the particular effects of definite weather states upon different diseases even if such exist; but it is possible in a general way to discover the physiological effects, as we have the mental effects, of the weather upon those in health and disease.

Upon *a priori* grounds the former could hardly be expected to be so marked as the latter, for the emotions are probably more delicate indicators of changes in the vital economy than are any of the physiological symptoms of disease. As is shown, however, by the curves illustrative of this chapter we have seemingly very considerable fluctuations in health which vary concomitantly with the weather, and which seem to be undubitable evidences that we are, to a marked extent "creatures of the weather" so far as our general health is concerned.

Four classes of data mentioned in Chapter V. have a bearing upon the question of health. The first of these, attendance in the public schools, has been discussed somewhat fully in Chapter VII., and will only be mentioned incidentally here. The second (class X, page 65) is also a study of persons supposedly in perfect health (the New York City policemen) to determine if possible the influence of the weather in the creation of a sick list. The third (class IX, page 65) comprises persons already weakened by disease, though not so severely as to necessitate confinement within doors; and fourth (class XI, page 66) persons in the last stages of disease. In the study of the Metropolitan Police, records headed, "Number of the force on the sick list each day during the year," printed in each annual report, were used. For the entire force of six thousand men, the list varied from 170 to 410, with a daily average of about 200.

The study of hospital patients covers medical cases only for the "outpatient" department. Medical cases were considered, since it seemed probable that with the surgical would be introduced a greater number of errors accidental to the problem. The weather may or may not have anything to do with falls and run-overs and burns, but the chances that it has are less with such mishaps than with cases of sickness, pure and simple. For the years studied, an average of 122 patients sought aid at the hospital daily, the extremes for single days being 42 and 206. The average number of visits made by each patient was three and a fraction, usually at intervals of several days, though in some cases, weeks.

I am convinced that large numbers of applicants for medical aid, under the conditions studied, are evidences of good physical condition rather than of poor on the part of the general "outpatient" clientage. At first thought, this may seem to be a most peculiar conclusion —to make hospital service a measure of health rather than of disease—but it seems to me that the conditions warrant such a conclusion. The group of persons which is under medical surveillance at the Roosevelt Hospital, a variable quantity, numbering roughly one thousand at any given time, is made up mostly of persons suffering from more or less chronic diseases which need only occasional attention and direction on the part of the physician at the hospital. This attention can be had only through a personal visit by the patient to the hospital, and to make such a visit, the person must have sufficient strength and vitality to undertake the ordeal of a considerable walk or car ride, and not infrequently a tedious and uncomfortable delay in the waiting room. This, it seems to me, would be undertaken only on days when the patient felt at his best, or at least could not be undertaken when at his worst. The class of persons who patronize the "outpatient" department of the hospitals are usually not the sort who apply for medical advice until health conditions are serious, a fact which would be in support of my conclusion regarding this class of data, viz., that *the number receiving attention varies directly as the health of the class we are studying,* emphasizing the fact that the class studied consists of roughly one thousand persons, all of whom are in a state of general ill-health. If this be true, the curve marked "Hospital" upon each of the figures of this chapter is indicative of health, when its readings are above the heavy "expectancy" curve, and of ill-health, when below. For the curve marked "Policemen," the conditions are exactly the reverse, since an excess of men upon the sick list means an excess of ill-health.

I recognize fully that in studying the question of health through a tabulation of outpatients at the hospital, an undesirable element is introduced, viz., that of the direct effect of certain weather states, such as excessive cold and heat, hurricanes and bad storms, in preventing the patients from making a visit, even though the general health be not influenced by such conditions. A study based upon the daily calls made by a sufficient number of physicians in their regular practice would eliminate to a considerable extent this element, but I have not been able, though I have made many attempts,

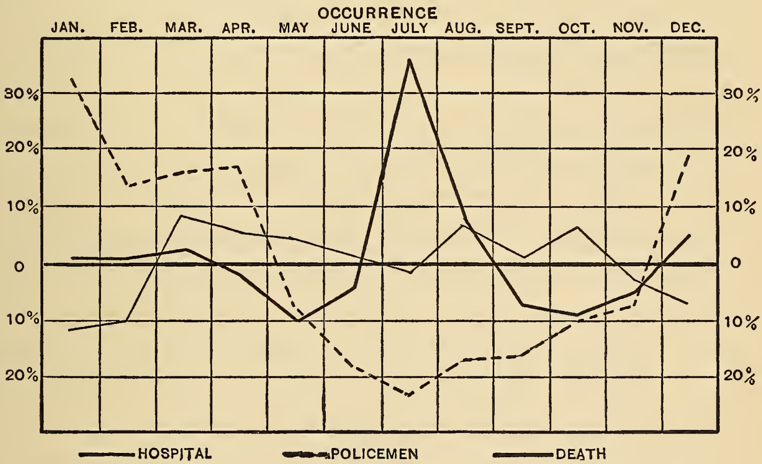


Figure 31

to secure the necessary data. If this paragraph should happen to meet the eyes of physicians practicing in New York City, having such records, I should be pleased either to furnish the meteorological data for their tabulation, or to take their records and complete the study myself.

The fourth class of data considered in the chapter, those for Death, need little explanation or comment.

An excess of death would mean in all probability a general lowering of the health plane, though it would seem from some of the curves as if certain conditions which were hardly felt at all by persons in perfect or only slightly impaired health were peculiarly disastrous to those *in extremis*.

Occurrence. The facts shown upon Figure 31 are not at all peculiar to this study and are accessible to any one upon recourse to the records, without use of meteorological charts or records. All the curves are in a general way corroborative of one another—except for the fact that the policemen seem to be immune to the effects of hot weather—and are, moreover, in accord with the indication of the curve on Figure 4, which shows the absence of pupils from the public schools. In a general way, the curves would indicate that health is poor during the first two months of the year, since many policemen were off duty, and few patients visited at the hospital. The death rate is not, however, particularly high, and it may be that the failure of the other two classes to get out of doors was not due to absolute ill health, but to the prevailing inclemency of the weather. In other words, our curves may simply show an inability on the part of reasonably good health to register itself as required by our problem. It does not seem to me, however, that this is the case, particularly with the policemen, since they are all men selected especially with regard to health and strength and would hardly wish for financial reasons to be laid off without some good excuse. Christmas and New Year celebrations may be considered such by them and on this curve,—though not upon those for definite meteorological conditions,—would such absences show. The fact that the death rate varies so little from the normal during the coldest months, while the other two measures of health do to so marked an extent, are indicative of the fact that the conditions of the sick room are under perfect control, except in cases of poverty. Low temperatures are the only weather states peculiarly characteristic of winter and the patient in the sick room need not know that the mercury is low out of doors. While this is true for the conditions of cold, it is not at all so for the other extreme of the temperature scale, as is shown by the tremendous mortality for the hottest month. If a larger number of years had been covered by the study, the great difference between July and August would not be shown, as it is due largely, if not entirely, to the fact that the former month for one of the years studied contained one of those terrible hot waves which New York City occasionally expriences, swelling the death rate to an almost unprecedented extent. Such a wave more frequently comes in August, and the crest in the curve for July must be interpreted as an accident of conditions.

The excess in the number of hospital patients for March and the fluctuation of the curve until the arrival of cold weather are, perhaps, rather measures of the size of the hospital clientage or group of persons who are making use of its advantages, than of ability to get about. I have stated that the former is roughly one thousand, but it is a variable quantity and the daily attendance at the clinic might, at a given period of the year, be large, either because a large percentage of a small group was in attendance, or because a smaller percentage of a larger group were with some regularity in waiting. March is not an easy month in which to get about in New York City, and it seems probable that the latter condition existed at that time.

In light of the fact that the July death rate was so large, and that a considerable preponderance of ill-health is indicated by our hospital curve, it is not to be expected that the sick list should be the smallest of the year for the policemen, yet that is what we find. Both this figure and the next (temperature) seem to show that our metropolitan guardians of the peace are absolutely unaffected by any extreme of heat covered by this study, a fact which places them in a class by themselves, so far as my observation goes. It is true that they are picked men, but are as susceptible to some weather influences as are any of the other classes studied. It is possible that a wise selection of uniform has contributed to this result. If so, we should all do well to model our hot weather apparel as nearly as possible after it.

Doctor W. A. Guy of London (see *Jour. Statis. Soc. London,* 6:133), undertook, many years ago, a study similar to mine of the hospital outpatients; except that it has only to do with the seasons of the year, it furnishes some interesting comparisons.

His statistics were for the outpatient department of King's College Hospital, London, for years preceding 1842, covering 9,000 cases. He also considered the London death-rate. The meteorological data consisted of monthly and quarterly *means* constructed by the Royal Society and appended to the Register-General's report. His first table is as follows;

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Mortality of London............	12,805	10,494	11,177	11,910
Mortality of Central District.....	2,510	2,148	2,183	2,345
Mean temperature..............	41.3	57.2	64.1	46.5
Rain in inches..................	3.69	3.03	9.19	6.01
Dew point (mean)..............	38°	50°	58°	43°
Mean Barometer................	29.91	29.93	29.81	29.88
Sickness........................	2,030	2,373	2,571	2,080

From this table, he asserts that there is no relation, whether direct or inverse, between mortality and any single condition of the air, but that the sickness follows the exact order of the temperature and the dew point, varying directly as each of them.

Having then discovered, apparently, some relation between weather conditions and sickness, he studies, in an interesting way, the effects of these meteorological conditions upon specific maladies with the result that he seems to discover two classes of diseases, one of which varies directly and the other inversely as the weather conditions. Although Dr. Guy's conclusions may not be of great value, the whole study is extremely interesting as showing the perfection with which the inductive method was applied to scientific investigation more than sixty years ago, and is well worth a reading on that score, if upon no other.

Dr. Arthur Mitchell also presents in *Nature* (12:321) some interesting facts relative to the prevalence of scarlet fever in London at different seasons of the year and under different weather conditions.

This paper gives the result of an investigation, the purpose of which was to determine whether the seasonal influence of the weather upon deaths from scarlet fever, as shown by the curve constructed from the figures of thirty years, would present itself if the period were broken up, and the curves constructed for the several smaller periods embraced in the long one. In London there have been six epidemics from scarlet fever, reaching their maxima in 1844, '48, '54, '59, '63 and 1870. Curves were constructed representing the average weekly deaths from scarlet fever for each of the six periods embracing these epidemics. These curves were then compared with the curve for thirty years, from 1845 to 1874, the leading features of which are that death from those diseases is above the average from the beginning of September till the end of the year, and below the average for the rest of the year; and that the period of highest death rate is from the beginning of October to the end of November, when it rises to about 60 per cent. above the average; and the period of the lowest death rate is March, April and May, when it is about 33 per cent. below the average. On comparing the curves for the six short periods of the thirty years, with the general curve, a remarkable similarity is found. The steady obedience to climatic influence, of fatality from a disease so epidemic as scarlet fever is very remarkable, and the more so, inasmuch as no other disease, with the single exception of typhoid fever, attains its maximum fatality in London under conditions of weather peculiar to October and November.

Temperature. If our conclusion regarding the relation between health and hospital attendance is a correct one, we have unmistakable evidence upon Figure 32 that low temperatures carry with them general ill health, which gradually improves as the weather grows warmer until a mean temperature of 70 degrees or thereabouts is reached, at which point the heat begins to be disastrous. As is shown by the curve for policemen, the sick list is 80 per cent. larger when the mercury is hovering about the zero point than when it is highest in the tube, and the variation from one extreme of temperature to the other is

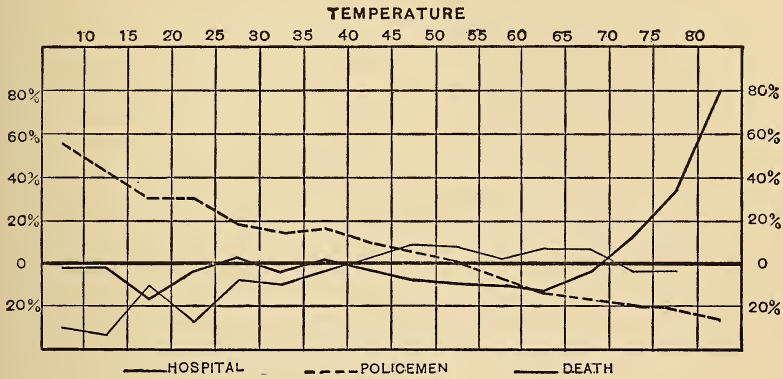
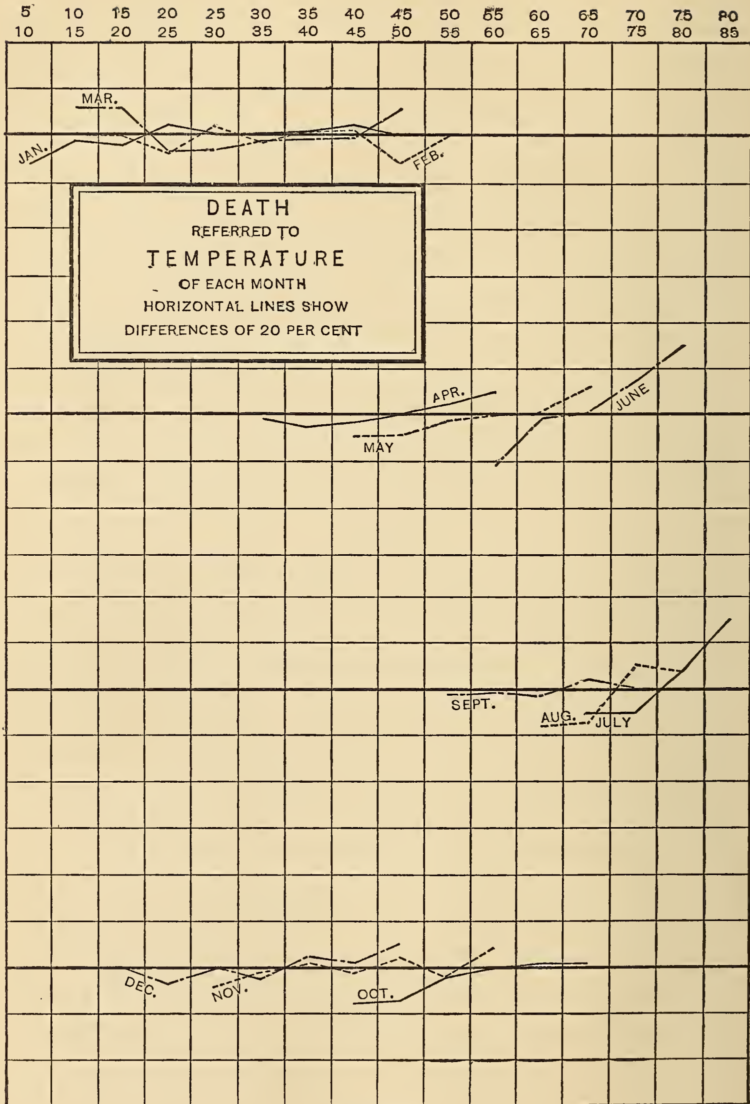


Figure 32

accompanied by an almost equally regular change in the sick list. With absentees from school the curve is practically parallel till a temperature of 65 degrees (mean) is reached, when the children begin to feel the effect of the heat unfavorably, and for the highest temperature group the attendance is worse than for the lowest. With the applicants for aid at the hospital, the same evidences of ill health are shown for the lower temperatures; at about 40 degrees the influence beginning to be favorable to health, with slightly unfavorable effects being in evidence for temperatures above 70 degrees. All things considered, this is what should be expected from the study of the occurrence table (Fig. 31), and does not vary much from what general experience, apart from any recourse to statistics, would lead us to predict. The curve based upon the death rate shows that variations in



5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85
MAR.
JAN.
FEB.
DEATH
REFERRED TO
TEMPERATURE
OF EACH MONTH
HORIZONTAL LINES SHOW
DIFFERENCES OF 20 PER CENT
APR.
MAY
JUNE
SEPT.
AUG.
JULY
DEC.
NOV.
OCT.

Figure 33

temperature have little effect upon mortality until excessive heat of 70 degrees and above is reached. As has been suggested, it is usually possible to increase the temperature of the sick room by means of fire when desirable, but to reduce it by artificial means is, with present systems of refrigeration, quite another matter; and we find excessive heat to be the most deadly of all the meteorological conditions studied, the death rate nearly doubling for temperatures above 80 degrees. Those from 40 degrees to 65 degrees seem to be the most manageable in the sick room, the death rate being below the normal at that time.

Figure 33, which is constructed in every particular as was Figure 14, shows in a very conclusive manner that only the upper extreme of the temperature scale has any considerable effect upon mortality. Upon it the death rate for each month is shown, so far as the influence of the varying temperatures of the month are concerned. As may be seen, the entire variation in temperature for each of the winter months is 40 to 50 degrees, with hardly any variation in the death rate between the two extremes. For the summer months, however, the facts are quite different, August having a temperature variation of but 20 degrees, with a death rate 60 per cent. greater for the group 80°-85° than for that of 70°-75°. Each of the summer months shows the same general effect, viz., a very rapid increase in mortality as the thermometer rises above 75 degrees. This fact is especially interesting in connection with that shown by Figure 14, which is, that assault and battery do not increase with the hot days of summer, but are especially aggravated by the unseasonably hot days of the spring and autumn months, which have little or no influence on the death rate.

Barometer. It was impossible to secure the barometric readings of the two years covered by my study of the death rate; so no curve for that is shown upon Figure 34. Those for the policemen off duty and the hospital patients, however, are given, and show beyond a doubt that periods of low pressure are accompanied by sickness; that moderate pressure is conducive to the best of

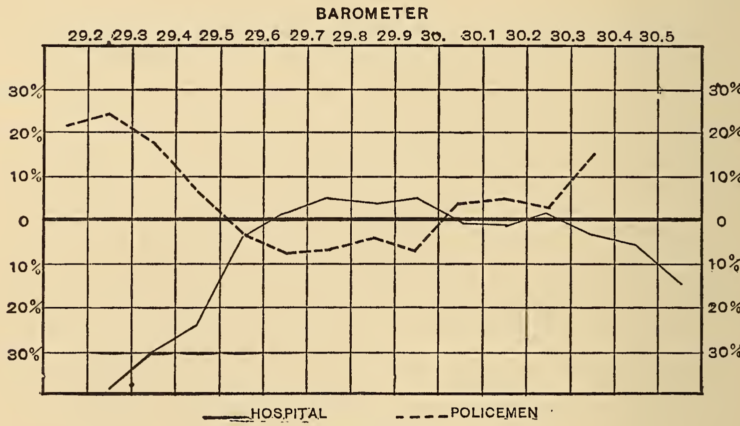


Figure 34

health and that illness is somewhat above the normal in prevalence again when the barometer is high.

In this latter particular the study of health differs from all the others given in this volume, for in the cases of all the other classes of data, deficiencies in occurrence are shown for high atmospheric pressures. This is an interesting fact, since the others have to do with activities—mental or physical,—while this is based upon sickness, which is, in a sense, a cessation of activity. The only other barometric curve which even approximately resembles these in this respect is that for clerical errors (Fig. 21), and with that, only a normal prevalence of mental slips is indicated. For the lower barometrical readings the curves for health resemble those for most of the other classes of data. The curve for school attendance (Fig. 6) corroborates in a very striking manner those upon Figure 34, showing the same indications of ill health when the barometer is high that are there expressed. On the whole, these curves go far toward proving that the active disorder of the schoolroom, the penitentiary, and upon the street, vary directly with health, for we have here shown conditions of air pressure which are accompanied by prevailing illness, and have upon other figures shown the same conditions of pressure to be conducive to good behavior. These facts are more fully discussed in the concluding chapter.

HUMIDITY. Upon Figure 35 we have again full corroboration of the relation already stated between health

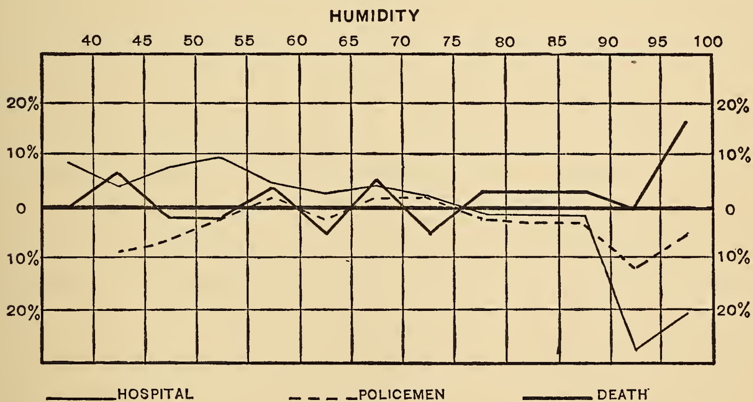


Figure 35

and misconduct. Here, both with the policemen and the attendants at the clinic, are indications of the best of health during periods of low humidity, with the reverse conditions of health for the clinic at the other extreme of atmospheric saturation. But active disorder has been shown to be universally high under the former conditions and low during the latter. Upon the policemen, great humidities seem to have no disastrous effect; in fact, they seem to thrive under them, another evidence of their immunity, at least to some atmospheric influences.

With the school children the case is similar to that for the hospital clientage, attendance being at its poorest when the humidity is high. Within the sick room, as is shown by the curve for death, different degrees of atmospheric moisture seem to have little effect until we reach a point near to saturation, at which we find a marked increase in mortality. It is not strange that the curve is practically negative for lower humidities—and I attach little weight to fluctuations like those for the groups from 60 to 80—for the humidity of comparatively tight, artificially-heated rooms is but slightly influenced by the outside atmosphere, and may be kept nearly uniform. I have on many occasions found differences as great as 20 per cent. between the humidity of the outside and the inside air, usually with the preponderance of moisture on the outside. An interesting problem is suggested by this fact, for I have shown in other chapters that periods of low humidity are accompanied by excesses in conduct which are indicative of peculiarly unbalanced emotions. If such be true for out of door conditions, why not for indoor? How much of our instability of temper is due to furnace heat and a crackling air? I shall leave the question for consideration at some later time.

Wind. If anything of an unexpected nature has been conclusively shown by this whole study of meteorological influences, it is the peculiar effect of calms. These effects are summarized in a later chapter, but Figure 36, together with the attendance curve upon Figure 8, shows beyond a doubt that atmospheric movements of less than 100 miles for the twenty-four hours —virtual calms—are attended by quite unexpected health conditions. For instance, the number of absentees at the public schools, normally about 9 per cent., jumps to 27 per cent., an excess of 300 per cent., reckoned in terms of expectancy, over the average for all velocities. For the same condition, too, the sick list at police headquarters is a long one, the hospital patients are too sick to get out in large numbers, and mortality is high, a combination of circumstances which can hardly be accidental when we consider the number of data considered.

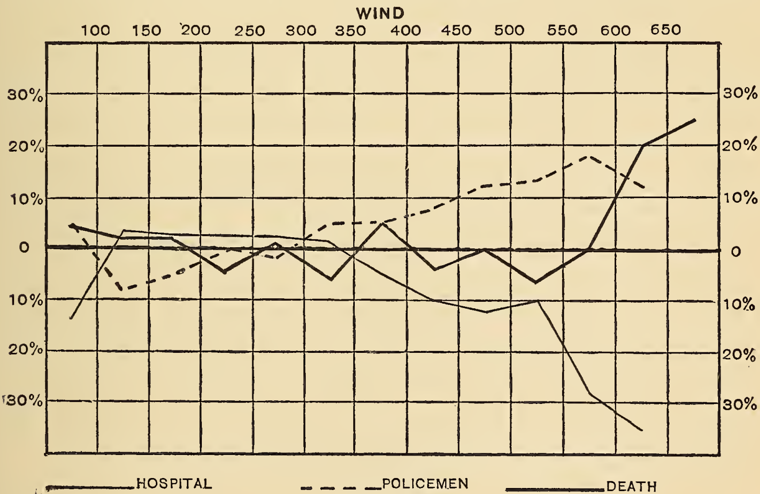


Figure 36

That this unusual prevalence of ill health and death for a weather state which carries with it none of the painful and uncomfortable qualities of extreme cold or heat or wind, is due to a lack of ventilation on a large scale (see page 262), there is no doubt in my mind. With sufficient movement to keep the mixture of gases which compose our atmosphere at their normal proportions, quite the reverse health conditions are brought about, remaining at their best until movements of from 300 to 400 miles per day are reached, at which point we have indications of unfavorable effects. It will be noted that the groups 250-350 miles mark the beginning of evidences of sickness, both at police headquarters and at the hospital, while the death rate is not materially influenced until much greater velocities are reached. We might infer from this fact that winds of from ten to fifteen miles per hour (250 to 350 total movement) are the lowest which are considered an excuse on the part of a person not feeling his best, for not venturing out, either upon his beat or for medical advice. The curves for wind, as a whole, tend to prove that ill health and good behavior among the classes studied, go together, since for great atmospheric movements, as well as for calms, we find both conditions prevailing.

The increased mortality for slight movements of the atmosphere which I have pointed out has been commented upon by Dr. S. A. Hill in an article, "The Effect of the Weather upon the Death Rate and Crime in India" (*Nature*, 29:338).

The study is based upon a record of 7,311,013 deaths from all causes in certain provinces of India for the years 1878-1882 inclusive. His unit of time is the month, and he makes a comparison of the average monthly mortality and certain forms of crime with the *means* of temperature, daily range of temperature, humidity, rainfall, and the velocity of the wind. He shows:

First: That the effect of rainfall upon health is so very indirect (through the production of food) as to form no part of the problem.

Second: That the relation between the death rate and the movement of the wind is inverse; the proportionate increase of death being 35.6 per million per month for a decrease in the velocity of the wind amounting to only one mile in twenty-four hours. In the months of October and November, when the so-called malarial diseases attain their maxima, the air is almost absolutely still; and there can be little doubt that if a moderate breeze were occasionally to spring up at this time of the year, so as to dissipate the malaria, or at all events to mix it with good air from other districts or from above, the effect would be an immediate decrease in the death-rate.

It is not plain from the paper what the effect of the other meteorological conditions is upon the death-rate.

Character of the Day and Precipitation. Judging from the three classes of data considered in this

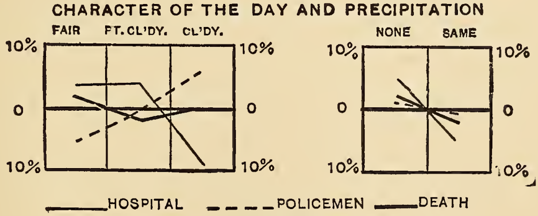


Figure 37

chapter, which necessitates a venturing out of doors in order to be counted, *i. e.,* school attendance, the police sick list, and the hospital applicants, we should infer that health is at its best on fair, dry days; based, however, upon the death rate, we should arrive at the opposite conclusion, for mortality is at its greatest under precisely such meteorological conditions, though not greater to a sufficient extent to carry much weight. In studying weather states which present such noticeably different characteristics as do those which we are considering, involving the whole gamut of weather, from the blinding storm to the most brilliant sunshine, the physical difficulties and actual danger to health from a venturing forth must be given full weight. Just how much these facts influence our curves we cannot tell, but undoubtedly to a considerable extent. It is possible that if the general health of the classes studied was the same for days of each of the characteristics shown upon the figure, that our curves would be as they are, simply as a result of precautionary and preventive measures taken by those solicitous for the health of the persons who form the basis of our tabulation. That is, a wife might keep the husband from his beat, not because he was ill, but because she was afraid the storm would make him so. Such cases are clearly within the realm of possibility and would, if enough blue-coats were so protected, give our curve the characteristics which it presents. I doubt, however, if such care would be exercised unless some symptoms of disease had already shown themselves, which the storm might be expected to aggravate; if so, we have disease, the *primary* cause of absence from duty, and not the weather, which would give validity to the curve. With the invalids under hospital care and the school children less serious symptoms than for the bluecoats might be taken as an excuse for remaining at home. Still I am of the opinion that save for the most exceptional weather, such must be present and that the evidence which our curves gives us, that general health is at its worst during bad weather, is valid. It certainly is in accordance with our general experience.

SUMMARY. Sickness and death are generally more prevalent during the winter and early spring months, though the latter (death) is tremendously increased by the intensely hot spells of the summer; sickness is aggravated by low temperatures, which do not much influence the death rate. The latter is, however, sent up by great heat; sickness is far above the normal during low barometrical conditions, and somewhat above for the other extreme. Both it and death show deficiencies for low humidities, with excesses for high, though the effects are not very pronounced; both are above the normal for calms; below for moderate winds; and again above for greater velocities; both are excessive for cloudy, wet days.

CHAPTER XI

SUICIDE AND THE WEATHER

Much has been written and rewritten on the subject of suicide. It has long been a favorite topic with the student of social statistics, and has been scientifically treated from the standpoint of race, of nationality, of social condition, of occupation and of climate. Whole volumes have been devoted to the problem and magazine articles almost without number. It is not, however, my intention in this chapter even to summarize the conclusions arrived at in all this mass of literature, but to discuss a phase of the subject which can not have escaped the reader of the daily paper, and which has long proved an enigma to the special student of the problem of self-destruction—that is, the daily fluctuation in the occurrence of suicide. Why is it that upon picking up our daily paper one morning we see the heading "Epidemic of Suicide," and find the details of six or eight or even a dozen successful or unsuccessful attempts recorded for the previous day—a number greater than for the whole week preceding? Yet such is often the case—so often, in fact, as not infrequently to have been the subject of editorial comment, with vague queries as to the cause of such a wave of emotional depression and consequent self-destruction.

The answers to this query have been many and varied, among the most frequent of which has been chance. Mimicry and suggestion have been proposed, and without doubt have their place in the solution of the problem of the periodical fluctuation of the suicide curve, but still can not account for all its peculiarities. The weather has also been suggested as the cause of the fluctuation referred to, and it is to the following out of this promising clew that this chapter is confined.

How much of all this fluctuation can be attributed to an east wind or leaden sky—in other words, to "weather effects?" In order to answer this question, we must define our term "weather effects." From the standpoint of our present study we should include within the category of weather effects any marked inequality in the occurrence of suicide which may be found to bear a fixed relation to fluctuations of the weather. We conclude that a fixed relation between a given weather state and an unusual prevalence of suicides is causal and not accidental. This is based upon an inductive study of large numbers of data, and is as valid as such studies can well be.

The problem, then, consists in discovering these fixed relations. It is in no sense an attempt to account for suicide, but for the irregularity of its occurrence. Man always has sought, and perhaps always will seek self-destruction as the relief for sorrow, fancied or real, and the basal reason for this is not to be found in the weather. We would not argue that the weather, save in very exceptional cases, drives people to suicide; but, on the strength of what follows, that under some weather states, other things are peculiarly liable to drive people to the act. In other words, that some meteorological conditions so affect the mental state, so influence the emotional balance, that ordinarily endurable things become unendurable, and life seems no longer worth the living.

This problem, which seems to show a causal nexus between the weather and the mental state of the suicide, is a comparison of the occurrence of suicide under different meteorological conditions, with the normal prevalence of those conditions, noting the excess or deficiency. The data were collected for New York City and the city of Denver, Colo., and although the climatic conditions of the two cities are very different, it is in no sense a comparative study for them. In fact, so few data (two hundred and sixty suicides) were procurable for the western town that but little weight is given to conclusions based upon them compared with the much greater number for New York City, hence the study of the former is only incidentally mentioned.

In order to procure the proper data of suicide for the city of New York, the records of the coroner for five years were carefully gone over (some 28,000 separate death certificates), disclosing the particulars of 1,962 suicides, and the exact number (varying from 0 to 9) tabulated for each of the 1,826 days of those years. Next the police records for the same five years were studied, and the number of unsuccessful attempts for each day noted. This record is quite complete, since in the eyes of the law, any one attempting suicide is a criminal, and must be so branded on the books. From these two sources were obtained the exact number of persons who for each day of the period covered, were of suicidal intent, unless some unsuccessful attempts escaped the surveillance of the police. In the present study, neither age, sex, nationality, nor occupation is considered; simply the fact that some one wished to die by his own hand—for the five years—2,946 in all for the city of New York.

Upon each of the figures used in illustration of this chapter the general meteorological condition is indicated at the top; the definite group readings are given in small figures upon the heavy vertical lines which represent the occurrence of suicide for the group. Expectancy for each group is represented by the vertical distance A-B, and excess or deficiency graphically shown in percentages of this, which may be read by means of the scale at the left.

The entire vertical lines (ordinates) are for the New York study and the dotted ones for Denver. For the latter the meteorological groups are, in some cases, double in size those of the eastern city. In every case, excess or deficiency of suicides is indicated by the position of the top of the ordinate with reference to the horizontal expectancy curve marked A-A.

Monthly Distribution. Figure 38 indicates very wide variation in the number of suicides occurring in the different months of the year, generally speaking, the heated months showing excesses and the cold ones deficiencies when compared with the normal. May and August show the greatest numbers, with the least for February, in spite of the fact that the shortness of the last-named month is taken into consideration.

It may be seen by an inspection of the figures that for New York the increase in number for each month from

February to August, and the decrease for the other months of the year, would give an almost perfectly regular *crescendo-diminuendo* to the occurrence curve were it not for the fact that April and May are raised out of their position by unusual excesses. Why April, which in its general weather characteristics is Elysian compared with its immediate predecessor, should show one-fourth more suicides, and May, which by common acclaim is one of the most delightful of the calendar, should present a number surpassed only by sweltering August, it is not easy to see. Yet such is the case for the five years covered by this study, and similar conditions have been demonstrated by other students of the subject. Morselli, in his exhaustive treatise for the European nations, finds that for thirty-two separate studies made by him, the maximum numbers were in June eighteen times and in May eight times. In explanation of the fact, he says: "Suicide is not influenced so much by the extreme heat of the advanced summer season as by the early spring and summer, which seize upon the organism not yet acclimatized and still under the influence of the cold season." There is little doubt that the end of winter brings with it a depleted condition of vitality, both nervous and physical; yet I

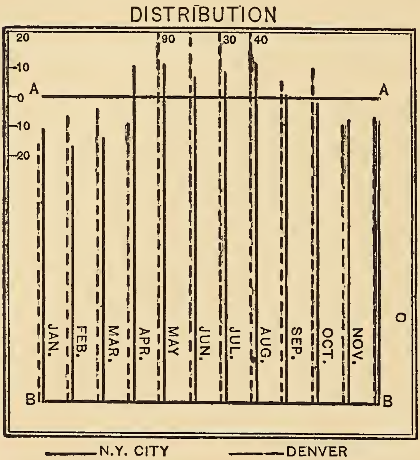


Figure 38

am inclined to think that the fact can not wholly account for the great increase in the later spring months. In the conclusion of this chapter the condition is again alluded to, and at this point I would simply call attention to the fact that the increase comes with the season of the year when rejuvenating Nature is in her brightest mood.

DENVER. As will be seen from Figure 38, the distribution of suicide throughout the months of the year was found to be very similar for the western city to what it was for New York. We have the deficiency for the colder months, and the excess for the heated season, with the greatest number of all—nearly double the normal—for May. The curve seems to show that heat was much more provocative of self-destruction in Denver than at the sea level, the excesses for the hot months being several times as great.

Mr. William B. Bailey, in a recent number of the *Yale Review* (May, 1903), has made some interesting statements regarding the distribution of suicide throughout the days of the week and also the hours of the day, which, although it has no bearing upon our problem of weather influences, is interesting from the general standpoint of distribution. His study covers the whole United States, considers the two sexes separately, and comprises 29,344 cases of self-destruction. He finds that for each 700 suicides the different days of the week figure as follows:

Day of the week	Total	Males	Females
Sunday	110.8	107.3	123.1
Monday	119.2	118.4	122.6
Tuesday	97.2	98.7	94.8
Wednesday	96.3	97.	93.5
Thursday	88.2	88.4	87.6
Friday	96.6	98.6	89.5
Saturday	91.0	91.6	88.9

Concerning the table he says: "Monday is the favorite day, followed by Sunday. From Monday down to and including Thursday there is a gradual fall, but on Friday there is a sudden rise that can not be easily explained. Saturday is, next to Thursday, the lowest day in the week. For those who have endured throughout the week, there is the pay day at hand followed by a day of rest. Among the males, Monday is preëminently the day for suicide; the money spent, and the spirits are often depressed as a result of the artificial stimulation of Saturday night and Sunday. Females prefer Sunday to Monday, but both are extraordinarily high. Religious excitement may have an effect upon this, but nearly a third of the suicides on account of domestic troubles come on Sunday. The family is there together for the day, giving greater opportunity for quarrels, or the husband may be intoxicated and the home seem dreary to the females."

In general the tables correspond with that of Guerry, based upon nearly seven thousand cases, though the latter shows suicide to be below the normal for Sunday. He ascribes the weekly rhythm of self-destruction, and also that for the days of the month to the effects of pay day, and believes that were it the custom for workers to be paid their wages, and bills fall due on the middle of the week or month, instead of at its end, we should find suicides most frequent where they are now most rare.

In groups of three hours each, the distribution of suicide throughout the hours of the day and night was shown by Mr. Bailey to be as follows, for a total of 10,000 cases.

Hour of day	Total	Males	Females
12 P. M. to 3 A. M.	506	404	102
3 A. M. to 6 A. M.	789	642	147
6 A. M. to 9 A. M.	1,098	908	190
9 A. M. to 12 M.	1,294	1,013	281
12 M. to 3 P. M.	1,398	1,082	316
3 P. M. to 6 P. M.	1,450	1,115	335
6 P. M. to 9 P. M.	1,408	1,096	312
9 P. M. to 12 P. M.	1,592	1,202	390
Unknown	465	319	146
	10,000	7,781	2,219

This table shows that 3,687 cases occur before noon, and 5,848 during the remainder of the day. Of the cases of murder, followed by suicide, roughly 70 per cent. were found to have occurred during the six hours from 6 p. m. to midnight.

Studies in France, Germany and Switzerland have shown quite the reverse condition, for in those countries suicide is more frequent during the morning hours than at any other time of day, from noon until about 3 p. m. coming next. On the question of rhythm in the occurrence of suicide, Dr. Strahan, in his "Suicide and Insanity," writes (pp. 158-159): "The yearly variation in self-destruction differs from these weekly and hourly variations in this: that instead of the exciting cause coming to the individual from the outside world, it comes to him from within. There is an annual rhythmic rise and fall which affects all animate nature. With the approach of spring and the increase of temperature, there is a general wakening from the period of comparative rest in which the preceding cold season has been passed. With this awakening, every function is quickened and the procreative, which is the highest of all functions, is excited to most vigorous action. During this period of spring and early summer the organism is working at its highest tension, and every function of mind and body is more active than at any other period of the year. It is not surprising, then, that at this portion of the yearly cycle we should meet with the most break downs of the machine.

"In this annual quickening of the functions of the organism we do not find a true cause of suicide, any more than we find a true cause of crime, immorality, or madness. It merely acts as an exciting cause to those predisposed. The normal or healthy person passes through this natural rhythmic vital disturbance without injury; it is only the abnormal to whom it acts as an incentive to unnatural acts. To the healthy individual, the heightened vital activity of spring no more suggests suicide than it does madness; to the abnormal it suggests that to which he is already predisposed. Thus, while one gives way to crime or the indulgence of the passions, another will become insane or commit suicide. It is a disturbing agent of great power, and acts in overthrowing the unstable, exactly as accidental disturbances of equal power may act at any period."

Temperature. Figure 39 seems to show plainly two things: First, that the greatest excesses of suicide are found at the two extremes of the temperature scale, when the conditions entailed the maximum of actual misery, and second, that the next greatest excesses occur

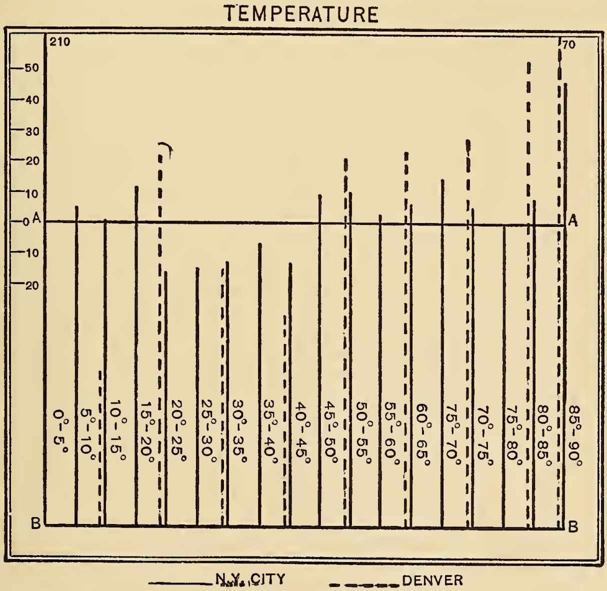


Figure 39

during the pleasantest conditions of temperature. I would here, however, call attention to the fact that upon all the figures, readings at the extremes of the conditions are based upon fewer data than are those nearer the middle, hence are more liable to accidental error. For example, although the temperature group, zero to five degrees shows an excess of two hundred and ten per cent., the condition occurred but twice in the five years studied, and the whole number of suicides was but eight, while the excess of fifteen per cent. for the group sixty-five to seventy degrees is based upon two hundred and sixty-eight. For this reason the value of the figures at the extremes of all the readings, except Figure 38 and the upper limit of Figure 41, at which point there were data enough to give validity to the findings, is lessened when compared with other points in the curves.

Taking this fact into consideration, the greatest numerical excesses in suicide occur in the temperature group from forty-five to seventy degrees. This places them within the category of most agreeable temperatures, for within those limits are found the monthly means of April, May, June, September and October. The deficiencies of suicide occur in the groups from twenty to forty-five degrees, conditions which are not generally considered most agreeable and within which are found the monthly means for the colder months of the year.

These results, however, are corroborative of the findings for the study of monthly occurrence, which show deficiencies for those months. The excesses for extreme conditions of heat and cold are perhaps only what might be expected. In the thickly populated tenements of the city, great heat becomes so oppressive as hardly to be endured, and at the other extreme of temperature, when the mercury of the thermometer is only in the bulb, both personal misery and a feeling of sympathy for a dependent family might prompt one to self-destruction as the last resort.

This curve does not differ materially from that of the assault and battery, except that in the latter it is shown that for the highest temperature ever experienced, those misdemeanors, as recorded by the police, show deficiencies. For them the numbers increase regularly up to a temperature of eighty-five degrees, but above that point they fall off very rapidly. This fact, however, is not hard to account for, since a considerable amount of energy is required to be objectionably out of order, and at such conditions of heat this seems hardly available.

The curve for Denver so nearly resembles that just discussed as to need but little comment. The only particular in which the two materially differ is that of the seeming effects of low temperatures. With them, the excess noted for New York City is lacking. If, as we have argued, actual physical misery is an incentive to self-destruction, this peculiarity is not surprising, for the thermometer is no measure of the discomfiture produced by cold in the two places. The so-called "wet bulb thermometer" registering "sensible temperature" would do so approximately, but it is not used in the construction of our figures. In the dry air of the altitudes, as is indeed true for the dry air of our Minnesota and Dakota plains, temperatures of zero and therabouts can be borne with much less suffering than those a score of degrees higher on the sea-board with its biting east winds, and without doubt the fact is shown in the deficiencies in suicides at the lower end of our Denver temperature curve.

Barometer. Considering the liability that accidental conditions affect the validity of our curves at their extremes, the results shown in Figure 40 prove conclusively that low conditions of pressure are accompanied by excesses in suicides, with corresponding deficiencies for the reverse barometrical readings. This is true both for

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the New York City and the Denver curves, the two presenting very similar characteristics for their entire lengths. Some interesting conclusions seem to be suggested by a comparison of them with the curve for

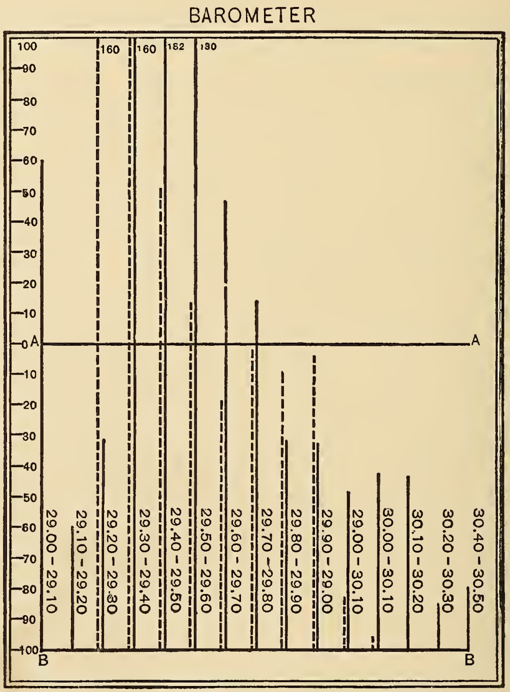

Figure 40

precipitation (Fig. 43). The latter shows that suicides are deficient (12 per cent. N. Y.) upon days when there is some precipitation, *i. e.,* stormy days, while the ones under consideration show them to be excessive during periods of low barometer. But the barometer readings are commonly low *just preceding* and *during the earlier stages* of storm, and seldom at other times. This fact would seem to restrict the period of excessive suicides, so far as its relations to storms is concerned, to those times, but the fact that Figure 43 shows that they are few upon wet days eliminates the storm period, and leaves us only the period just preceding storms as one of especial self-destruction. If so, it is precisely the period of "storm feeling" which is found so unendurable to sensitive natures, and which has figured so prominently in weather lore and literature. From our curves it would seem as if the man or woman on the verge of despair found this the one straw too much, and ended it all.

Humidity. The results of the New York City study of suicide for this condition (Fig. 41) are in themselves conclusive, but directly opposite to those found in similar studies made for assault and battery, deportment in the public schools and the New York City penitentiary, and the behavior of the insane. For suicide, the excesses are for high humidities; for the others mentioned they were for low.

The showing for suicides seems to be what would be naturally expected if we were to theorize on the matter, as those unendurable "sticky" days, when one feels it is his prerogative to be "out of sorts," are usually of high humidity. There are some interesting conclusions to be drawn here by a comparison of this curve with that for precipitation. The latter showed deficiencies of suicides for rainy days, while this gives an excess for humid ones. Now, all rainy days are humid, but not all humid days are rainy, and our logical conclusion must be that the excesses shown by the present figure must have been for the humid variety, yet without precipitation. Such precisely is the "sticky" weather mentioned, and its effects must have been deadly to produce such results.

In accounting for the unusual number of assaults and misdemeanors in the public schools for low humidities, as discussed in Chapter VII., the electrical potential of the atmosphere for such meteorological conditions was

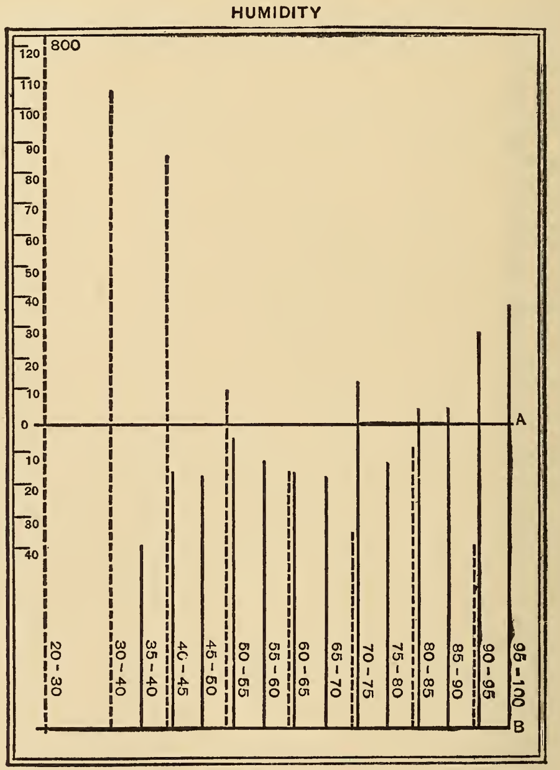

Figure 41

considered the cause. It is a fact conceded by scientists that at every point upon the earth's surface there are lines of electrical force extending off into space, and that the potential is roughly in a reverse ratio to the humidity prevailing at a given time. This electrical condition for regions of universally low humidity, as the altitudes of our western plateaus, is very marked and productive of no slight effects. As is shown for the Denver curve, these seem to be a mental and even physical exhilaration, productive of energy which in the long run generally proves to be in excess of the normal healthy possibilities. The result is for those regions a tendency to overwork, especially mentally, with a resulting state of collapse. Although these conditions are not so marked for the greater humidities of the sea level, they nevertheless exist to a degree, and without doubt in New York City there is less individual surplus energy when the humidity is relatively high, than when relatively low. This would lead us to infer that from the showing of this condition, suicide was excessive when energy was low. This relation of occurrence to available energy is reversed for certain of the figures, but other conditions enter in which are discussed in the conclusion of this paper.

Denver. For the Colorado climate the effects of humidity seem to be quite the reverse of those for New York City, as is shown by the dotted ordinates upon Figure 41. Here (*i. e.*, for Colorado) we note that the excessive prevalence of self-destruction is for small humidities. The conditions are not, however, quite comparable with those of New York, for the degrees of atmospheric dryness for which such excesses prevail are never experienced in the latter city. Their unusual effects upon conduct have, however, been discussed in previous chapters.

Wind. But little need be said upon the effect of this factor as shown by Figure 42. The regularity of the increase of suicide with increase in movement of the wind is too marked to allow any other theory than that of a causal nexus. This effect seems to be much greater upon the suicide than upon any other class of the offend-

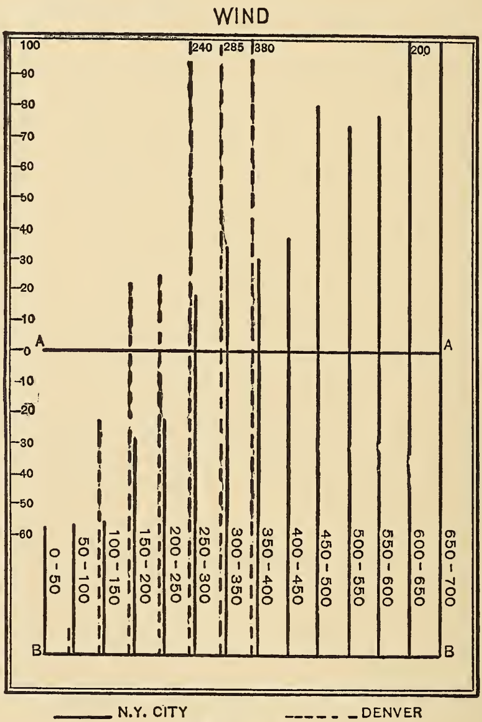

Figure 42

ers. Studied for New York City, and for the Colorado climates, the effects of great velocities of the wind is simply appalling, suicides being from two to four times the normal frequency during their prevalence.

Character of the Day and Precipitation. Figure 43 discloses some unexpected facts, namely: that the clear, dry days show the greatest number of suicides, and the wet, partly cloudy days—the gloomiest of all weather—the least; and with differences too great to be attributed to accident or chance; in fact, for New York City thirty-one per cent. more on dry than on wet days, and twenty-one per cent. more on clear days than partly cloudy. As will be seen, on cloudy days the occurrence was about normal. What does this mean? Must fiction resign her right to bring in gloomy weather and blinding storms as a partial excuse for ending an existence made more unendurable by these? If such be the case, it is well that Dickens and Lytton and Poe are gone, for they would be robbed of a large number of their tragic climaxes. England has (as has been said, page 83) long been characterized as "gloomy Britain," and Montesquieu has called it the "classic land of suicide," stating that the "excessive number of suicides for that country is due to its gloomy weather." Statistics have shown, however, that the number is not excessive there, being less per million inhabitants than for any other important European nation.

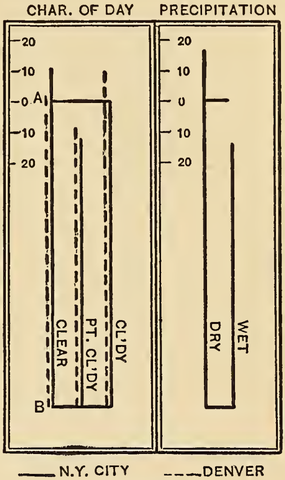

Figure 43

On this point, the quotation from *Once a Week,* printed on page 84, bears directly.

Certainly a comparison of suicides for Denver and New York City supports his theory, for in the former city, where cloudy and partly cloudy days are less than one-third as frequent as in the latter, we find suicide excessive during the gloomy weather. Yet the conditions there, both social and climatic, are so unusual as to give this fact little weight in a comprehensive study of suicides, and we must maintain that Vilemais's dictum that "nine-tenths of the suicides occur in rainy or cloudy weather," is wholly unfounded upon fact, at least for the conditions covered by this study.

It is difficult to summarize the results of this chapter in such a manner as to be of much value or to bring forward theories which are certain of any long tenure of life. The whole method of the study is too new and untried, and the number of data inadequate. The bare facts revealed in the preceding paragraphs must prove of much more value than any hypothesis drawn from them at this stage of the investigation. Still, there are a few generalizations which seem worth noting, especially as they are based in part upon findings which are entirely contradictory to popular opinion with regard to the time chosen by the suicide for the final act.

The first is that suicide is excessive under those conditions of weather which are generally considered most exhilarating and delightful, that is, the later spring months and upon clear, dry days. Reference to Figs. 1 and 2 proves this conclusively for the number of data and the locality studied. It was also noted that there were the greatest numerical excesses for the most agreeable temperatures. Barometrical conditions can hardly be referred to the categories agreeable and disagreeable, but for humidity and wind the relation will hardly hold, since we have the greatest excesses during high humidities and great wind velocities, both of which are unpleasant. Yet these facts would not invalidate our first statement, for neither high winds nor great humidities bring a scowl upon the face of Nature that can be compared with that of a wet, drizzling day. In fact, a day may be bright, and be both windy and humid. Yet these latter conditions have effects peculiarly their own, as shown conclusively by the study of deportment already cited. They are, for wind, the production of a neurotic condition in which self-control is in a marked degree lessened, and for high humidities, the production of a minimum of vital energy. The former is shown especially in the study of the school children, and the latter of the death rate. These facts make it possible for us to amend our statement that suicides are excessive during the most noticeably delightful conditions, by adding: coupled with especially devitalizing ones.

But this does not in any way account for the seemingly anomalous effect of bright weather. To me the only plausible hypothesis is that of contrast. Investigation has seemed to prove that very few suicides are committed on the "spur of the moment." The act is generally premeditated, and its consummation deferred, sometimes again and again. We can hardly doubt, either, that it is dreaded, and the hope entertained, even to the end, that it may not need to be. During the winter months that hope must be centered on the belief that when Nature smiles with the spring sunshine all will be well; on the gloomy day, when the morrow comes with its exhilarating brightness, the present cloud of unhappiness will be gone. The love of life is still strong, and the grave can not be sought while there is still hope for better things.

Spring comes with all its excess of life, and the morrow with its brightness, but do not bring to the poor unfortunate, unable to react to these forces as of yore, the hoped-for relief. He thinks of other springs when the blue-birds sang happier songs, and of other sunshine which had set his blood tingling. The drowning man had waited long for the straw; it came and he clutched it, but it sank beneath his weight. Dante felt the force of it when in his "Divine Comedy" he wrote,

> "No greater grief than to remember days
> Of joy, when misery is at hand,"

and Tennyson expressed the same thought in "Locksley Hall":

> "Comfort? comfort scorned of devils! this is truth the poet sings,
> That a sorrow's crown of sorrows is remembering happier things."

Summary. Suicide is most prevalent in the late spring and the summer months; is excessive at both extremes of temperature, and somewhat above the normal for days of moderate heat; is excessive in medium pressure of the air, and deficient for the extremes of pressure; increases with regularity as humidity and wind increase from a deficiency for low readings of both; is excessive for clear, dry days.

CHAPTER XII

DRUNKENNESS AND THE WEATHER

At first thought there would seem to be very little connection between the prevalence of intoxication, and the weather. Most of us can probably not recall a time when the latter has driven us to drink. Yet the influence of different weather states upon conduct has been shown to be so great by other studies as to warrant some little expectation of positive results, even at the outset, of this. With a great many people the occasional debauch is not a matter of mere caprice. It is not even by them a thing to be desired. The pleasures connected with it in no way compensate for the attendant hardships and miseries, both of body and mind. They struggle against it with an intensity unknown to those whose bodies have not been weakened by indulgence, and when the fight is finally lost, it is because the allurements of the glass are stronger at the moment than at any previous time during the struggle, or the ability to withstand them less. The weather could not, with any degree of probability, influence the former. It is not beyond the bounds of reason to suppose that it might the latter, through affecting the vitality of the body, together with its accompanying mental states, and it is for the purpose of throwing light upon this possibility, with its important bearing upon the drink problem, that the present study was undertaken.

The data were taken from the records of the New York City Police Board, and consist of the entire number of males arrested for intoxication (44,495) for the years 1893-95 within the city (now the Borough of Manhattan). On each of the figures used in connection with this chapter, the distance from the bottom to the horizontal line represents the normal, the distance from this line

MONTHLY DISTRIBUTION

Figure 44

to the top of each of the ordinates, the excess or deficiency, which may be read in percentages by means of the scale at the left. The first figure (Fig. 44) shows the prevalence of drunkenness for the months of the year. A mere glance at it shows the marked peculiarity to be a deficiency for the hot summer months, and a corresponding excess for the colder ones of winter, there being 47 per cent. less for July than for December, with a somewhat gradual change from one to the other.

These differences are too great to be ascribed to mere accident, though exactly what their causes may be is somewhat uncertain; in fact, an analysis of the conditions indicates the possibility of at least three. The first is the effect which certain holidays might have upon the occurrence of drunkenness. Undoubtedly some days of the year are made the occasion of a drunken debauch by persons so inclined, and Christmas is one of them. This would tend to increase the number of arrests for December. But the Fourth of July is perhaps just as much of a favorite for such diversion, a fact which would swell the numbers for July. This month, however, fails to show any such effect. In fact, a careful inspection of the daily record of arrests for drunkenness, although showing a slight increase for the festivals mentioned, proves it to be too small to account for the monthly showing. The excesses for the cold months are due to a large daily occurrence, pretty evenly distributed, and the deficiencies for the warm ones to the reverse conditions. Although November shows a considerable excess, I could not tell with certainty by an inspection of the records exactly which was election day, so slight was the increase in the number of arrests for it. It is true that the record for October may be influenced by the fact that the political campaign is at its height, but how much we cannot tell.

Another social condition which may affect the results is the exit from the city for the summer, of many who are brought with some regularity during the other months, before the bar of the police court. Undoubtedly Coney Island—which was not within the city limits when the data for this study were taken—and many of the other shore resorts, form something of a safety-valve for the New York police during their season, but my study of assault and battery would lead me to believe that the influence of this exodus cannot be great. It would be reasonable to infer that arrests for the latter crime and for drunkenness would be made, for the most part, from the same social stratum, and that social conditions which would affect the prevalence of one of those crimes would have the same influence upon the other. A moment's thought will be sufficient to show that the summer exit of the frequenters of the up-town clubs would not affect the police courts in the least, for they never come before its bar, no matter how often they are carried home unconscious in a cab. We are dealing only with those who get publicly drunk, and those are they who occasionally vary the monotony of a plain drunk with a fight. We could, then, with reason, infer that if the public drunkards were gone in any considerable numbers, the public brawlers would be also. Yet this is preceisely the reverse of what our study of assault has shown. Upon Figure 44, I have shown by means of a curve in dotted lines, the occurrence of arrests for this crime for the same years. It shows as marked excesses for the warm months as we have deficiencies for drunkenness during that season, a fact which would lessen the validity of, if it did not entirely negative the weight of any migration theory which might be brought to bear upon the problem under discussion.

The third hypothesis which might be promulgated is that of the direct influence of the peculiar meteorological conditions, and it seems to be the most plausible. Since, however, the remainder of this chapter is made up of a discussion of these conditions, I will simply state here that the prevailing ones for the summer months for New York City are high temperatures, barometer and humidity slightly below normal, light winds and generally fair weather.

Temperature. Figure 45 shows in a very marked manner the seeming effect of differing conditions of temperature, upon drunkenness. In explanation of it, I would say that the exact relation between expectancy and occurrence was worked out for each of the tempera-

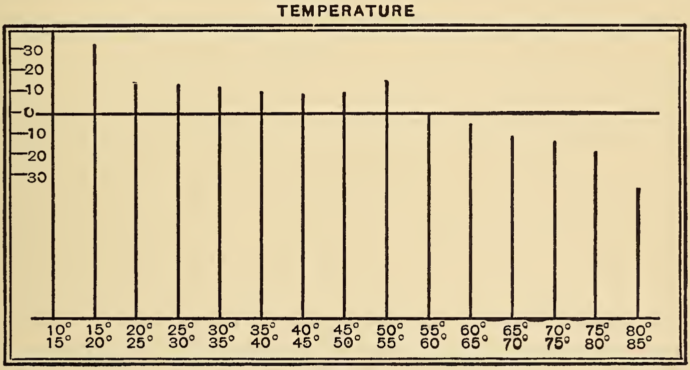

Figure 45

ture groups indicated at the bottom, and this relation shown for each group by the height of the ordinate above. Low temperatures made business for the police courts, and high ones lessened its labors. Of course, if our conclusions in the preceding paragraph on occurrence were erroneous and the deficiency in drunkenness for the summer months was due to social, rather than to meteorological influences, conclusions drawn from this figure would also be false. In that case, deficiencies for high temperatures shown here would be but concomitant variations. The summer is hot. If there be but few arrests for drunkenness during the summer, there can be but few for high temperatures. On the other hand, if high temperatures so affect the individual that less stimulant is desired than during those which are lower, we have here the cause of the peculiarities shown in Figure 44. There are some reasons for believing that this is the case. In the first place, the other studies of weather effects have seemed to show that during moderately high temperatures the vitality of the body is relatively excessive, while for low temperatures it is deficient. These facts in themselves would affect the demand for stimulant. A "bracer" is taken when *needed,* and for many a "bracer" means a "drunk." We may, I believe, with justice, conclude that many of the habitués of the police court as prisoners, struggle against their tendencies to drink, knowing the consequences. When vitality is excessive, they do so with success; for days and, perhaps, for weeks they are winners, but finally the time comes when the fight is too severe, and they succumb. That was on the day when the vitality was at its lowest ebb, and the cold contributed to that condition. A few glasses of whiskey would remedy all that, and it did so. What cared the poor fellow what arctic explorers have said about the effect of alcohol upon the system in the long run? He was cold; he was weak. The stimulant would give him immediate, though temporary, relief. He took it, and our figure shows the result.

Perhaps another influence of different temperatures shown by our figure is through the kind of alcoholic beverage used. In hot weather a man drinks beer; in cold, whiskey. During the former conditions of temperature, the body demands large quantities of liquid, which, through the excretions of the skin and attendant evaporation, may reduce the body temperature. Beer meets this requirement, and at the same time furnishes alcoholic stimulant, yet in quantities so small as to intoxicate only when taken immoderately. Yet, if our theory is correct, the condition of vitality is such that even this small amount more nearly meets the demands of the body than during the cold season, and consequent drunkenness is less frequent.

Barometer. The facts shown by Figure 46 are not

BAROMETER

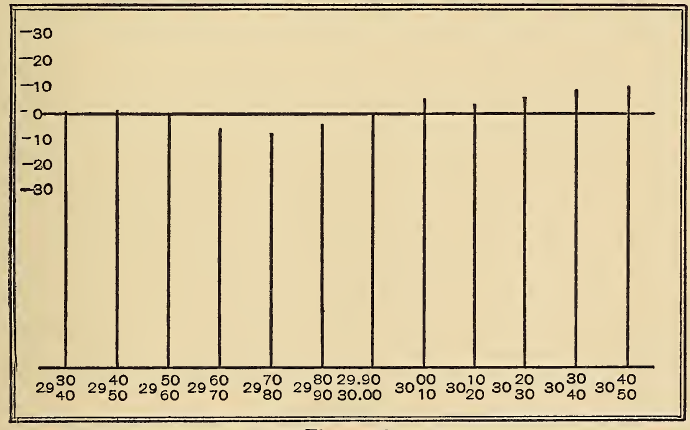

Figure 46

so conclusive as the preceding. In it we have the prevalence of drunkenness for different conditions of the barometer. To generalize from it we may say that the excesses were for high readings of that instrument. It is not easy, with our present knowledge, to account for this. Both high and low conditions of the barometer are distributed pretty evenly throughout the year, so we cannot attribute it to any effect of the season. It is possible that it may be due to the effect of storms upon the vitality of the body, and the consequent demand for stimulant. The barometer is not normally high during periods of bad weather, but usually follows them pretty closely with a rise, and it may be that although the "bracer" has been struggled against during the prevalence of a storm, at its close bodily conditions are such that the fight is given up, and a debauch follows. It is certain that the actual weight of the atmosphere, as indicated by the barometer, is not the influencing factor. The entire variation in the height of the mercury column for New York City is but little more than one inch, while in going to an altitude like that of Denver, Colo., a change of more than five times that amount is experienced without any noticeable influence upon conduct. The showing for this figure must, we think, be due to other weather conditions which vary with the barometer, yet what they are cannot be said with certainty. We may add that the seeming effect of different barometrical conditions upon the tendency to drink, is exactly the opposite of that upon the occurrence of misdemeanors in the public schools and penitentiary, of arrests for assault and battery and of suicide.

Humidity. The fluctuations in the height of the ordinates upon Figure 47, which shows the relation between drunkenness and varying conditions of humidity, is very great; so much so as to make the curve a hard one to interpret. We have there shown, not only excesses in the number of arrests during high humidities (*i. e.*, during much moisture), but also during those which are lower than the normal. Yet in spite of its circumflexion, the general showing of the curve is an increase of drunkenness with an increase of humidity. This might with reason be expected. First, the seeming temperature of a cold day in winter is much lower when the humidity is great than when it is small, necessitating, perhaps, more stimulant to keep up the proper vitality under the former conditions than under the latter. Second, on a day on which the humidity is great in summer, evaporation from the surface of the body is less rapid, and, as a consequence, beer, the ordinary summer beverage, loses to an extent its cooling properties. A logical

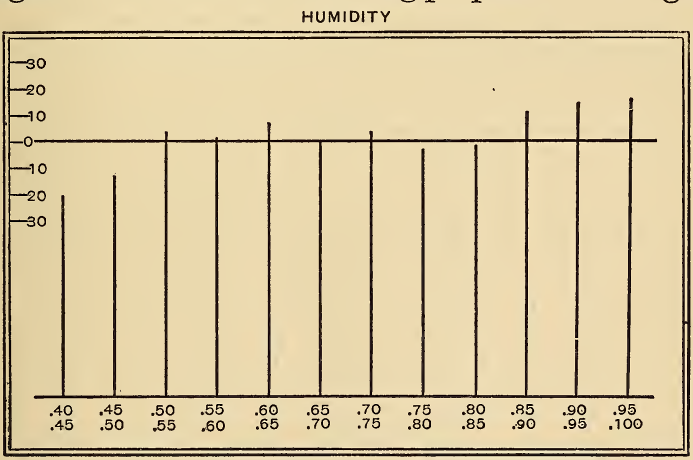

Figure 47

inference would be that less would be drunk with the consequent effect upon the prevalence of drunkenness.

Beside these hypotheses based upon the relation between humidity and temperature, is one having to do more directly with that between the former conditions and the vitality of the body. The studies of weather-effects already presented have seemed to show beyond a doubt that vitality is greatest during weather states of small humidity. At such times, the death-rate is lower, and disorder of an active nature more prevalent. My studies have shown that then, the electrical potential of the atmosphere is higher—itself a stimulant without being an intoxicant—with the natural effect that less alcohol is needed, with the danger of the police court consequently lessened.

WIND. Figure 48, with its row of ordinates regularly increasing in height, argues strongly that high winds are among the saloon keeper's best friends. The numbers beneath the individual ordinates show the total number of miles the wind blew for the days which, grouped, give the results shown graphically above.

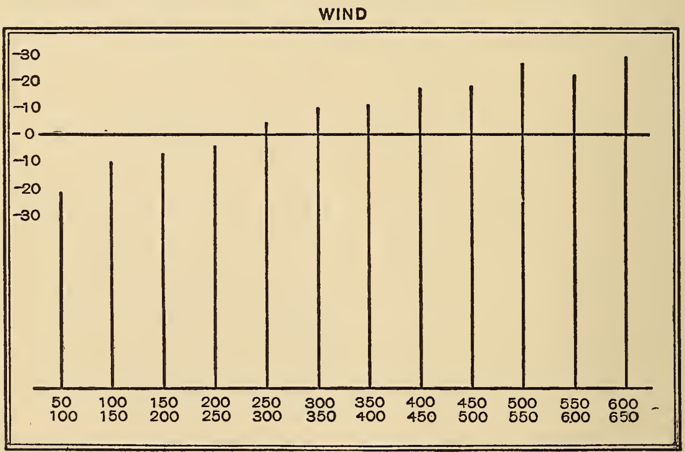

Figure 48

From a deficiency of 20 per cent. for conditions of virtual calm, to an excess of 50 per cent. for wind, the velocity of a hurricane, the increase is very regular. In referring conditions of the wind to those of temperature, the same can be said in part for high winds that was for great humidities, namely, that they intensify the effects of cold. The effect of great heat is, however, usually modified by a movement of air, although evaporation from the surface of the body is augmented, and the demand for liquid refreshments increased. This latter fact would swell the consumption of beer at such times. Our figure seems to show that such is the case.

Upon Figure 49 are shown the relative number of arrests for drunkenness upon days characterized by the United States Weather Bureau as "clear," "partly cloudy" and "cloudy." As so characterized, clear days

CHARACTER OF DAY AND PRECIPITATION

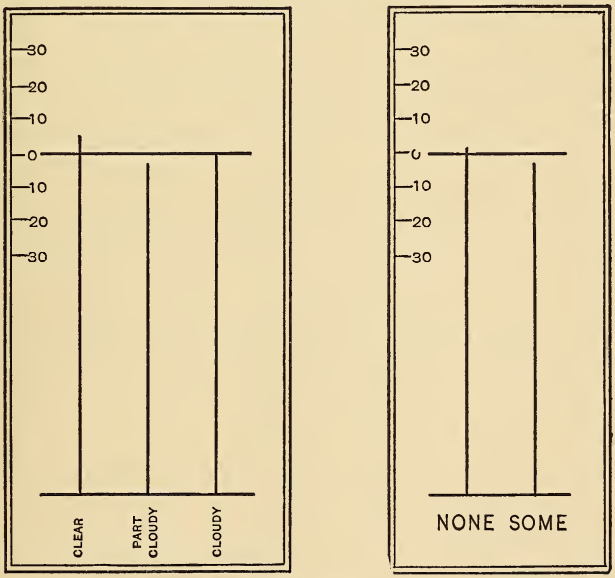

Figure 49

are those upon which the sun is obscured for three-tenths or less of the time from sunrise to sunset. As partly cloudy when from four-tenths to seven-tenths (inclusive) of that time is obscured, and as cloudy when more than that amount. Under precipitation, I have contrasted those days upon which there was rain or snowfall in excess of .01 inches with those on which there was none, without taking into consideration the amount.

Considering the influence of some of the other meteorological conditions, as temperature and wind, the effect of these most noticeable differences in weather seems very slight. In fact, so slight are they as to come within the computed "probable error," and perhaps can be taken only as negative results. Such as they are, too, they are contrary to what we should expect from a study of the other conditions and to our line of reasoning. The other conditions show excesses of drunkenness for debilitating weather states, and deficiencies for those which are exhilarating. Here we have the reverse, for clear and dry days which are bracing give us excesses, though very slight ones, while partly cloudy and wet days show deficiencies. Cloudy days furnish exactly the normal number.

It is hardly worth while, however, to attempt to account for these anomalies since they are so small as to come within the probable error, and may or may not mean anything at all.

In conclusion, I would say that I recognize the limitations of this method of study. By its very nature each meteorological condition is treated as if the others were not at the same time potent. This fact would introduce no error unless two or more tended to vary simultaneously. In that case the effects of one might be imputed to another. If all tended to vary without fixed relation to one another the showing for each would be valid, and a careful study of weather fluctuations seems to show that this is largely the case. We recognize, too, that a study of drunkenness does not have quite the bearing upon the question that one based upon the consumption of stimulants, as influenced by weather conditions, would have. We have argued that the latter affect to a recognizable degree the vitality of the body, and that deficiencies are compensated for by the use of alcohol in some of its forms. But in studying drunkenness we are missing entirely all those whose "bracers" did not lead on to a debauch. Where the feeling of depleted vitality led one man to the police court it probably led a hundred others to the sideboard or to the saloon for a drink, but of these we know nothing. It may be possible at some future time to base a study similar to this upon the daily output of some large city saloons, with striking results.

Certain it is that the great drink problem cannot be solved without having more scientific light thrown upon the psycho-physiology of the mass. As long as people demand stimulant it will be obtainable. Lessen the demand, and the attendant suffering will keep pace with its decrease. We cannot hope to alter prevailing meteorological conditions, were we convinced of their direct bearing upon the problem, but we can lessen their influence by shielding the unfortunate from their rigors, and by increasing in every possible way the normal vitality of the class which most needs it.

Who can say how largely the drink problem is one of better heated tenements, of warmer overcoats and of more nourishing food!

Summary. Arrests for drunkenness are far more prevalent during the colder months of the year than during the warmer; vary inversely as the temperature, being excessive for low and deficient for high readings of the thermometer; are but slightly affected by varying atmospheric pressure, though are somewhat above the normal for conditions of high barometer; increase as both the humidity and the wind increase; show slight influences from days of different character, though are somewhat excessive for clear, dry days.

CHAPTER XIII

ATTENTION AND THE WEATHER

This chapter comprises a study of intellectual processes, in their relation to meteorological fluctuations. I had hoped to make it more comprehensive by including within it the consideration of daily marks of pupils in the public or other schools; but all attempts to secure records of such marks have proved futile and I am forced to content myself with those considered, which are of a quite different character, though just as truly having to do with intellectual processes. Since it seems probable to me that a fluctuation in attention is the determining factor in the operations considered, I have given the chapter the above title.

A. CLERICAL ERRORS. This class of data was studied as a partial substitute for one of daily marks in the Public Schools, when it became certain that the latter were not procurable. It seemed particularly desirable to have as full studies as possible of the effects of meteorological conditions upon those mental states which are productive of intellectual results, as well as those affecting conduct, but they are necessarily limited to these data and those of the class following. They comprise 3,697 clerical errors in calculation, made during the calendar years 1896 and 1897 by about 140 clerks in several of the larger New York City banks, located between Park Row and Wall Street. The errors were all of such a nature as to bring about a difference between the record of the depositor and that of the bank, and were in no case corrected until some subsequent time. It was the record of such corrections, together with the date of the error, that was kindly put in my hands as the basis of study. Without doubt, very many more errors are made daily by the clerks in making up their "Cash," but as they are corrected before the day's work is considered done, and no record is kept of such, they were not available.

Occurrence. This curve (Fig. 19) shows the same general tendency to rise during the summer months that is shown for most of the other classes, with the difference in other respects, of a marked deficiency for April and May and an unusual excess for October, November and December. The curve resembles more nearly that for death than any other occurrence curve, which might mean, if this resemblance were more than accidental, that the number of errors forms an inverse ratio to the vital energy at command. In the summer months, when the latter is undoubtedly depleted by the excessive heat, the number comes up. In the spring, when, judging from the deficiency of deaths, vitality is strong, the number goes down. The excess in March is certainly not due to the high winds of that month, for reference to the "Wind" chart shows us a deficiency of errors for such conditions. It may possibly be due to a depletion of energy due to the physical difficulties attendant upon getting about in this month, uncomfortable both under-foot and overhead. The deficiency for September is, I believe, due to the general condition of vigor which comes with cessation of heat and the bracing coolness of the autumn. The excess of the next three months is hard to account for upon meteorological grounds. I am inclined to think it due to other conditions powerful enough to overcome any tendency of the weather which, theoretically, would be to place it below expectancy. These conditions are business and social and are suggested by the following peculiarity of distribution of errors for the days of the week. A tabulation for this condition showed little of interest except that there was an excess of errors for Mondays, of 24 per cent. This fact immediately suggested late Sunday evening calls and other festivities of the day, with their tendencies to divert the mind from business channels; but in talks with the officials of the banks studied, increase of business for that day was mentioned as a possible factor in producing the result. It was explained that a two days' mail was received from all outside towns, necessitating much extra work on the part of the clerks, and consequently, hurry and increased liability to error. The possible validity of my suggestion was also acknowledged. To apply these facts to the problem of monthly distribution: both an increase in business and in social requirements come with the late autumn and early winter months. Thanksgiving and Christmas, with their tendencies to distract, are included in them; and it does not seem unreasonable to believe that with them, came enough *Monday* effects to throw the curve where we find it, above the normal.

Temperature. The general tendency of this curve (Fig. 20) is the same as those of all other classes of data with the exception of Deportment in the Public Schools: that is, a gradual increase, until the temperature group 75 to 80 degrees is reached when the increase is very rapid, running up to an excess of 66 per cent. for the group 85 to 90 degrees. These conditions resemble so closely other curves which have been fully discussed as to make it unnecessary to comment upon them here.

Barometer. This curve (Fig. 21) differs essentially from all the others for this meteorological condition, in that it shows a deficiency of data for low barometric readings and an excess for high ones. This, coupled with the fact that it is the only curve dealing with the intellectual, rather than emotional states, makes a peculiarly interesting one. It is also, in some ways a contradiction of the results obtained from the experiment in discrimination, since there we find high barometrical conditions accompanying quick discrimination. It is, of course, possible, though the data are not at hand to demonstrate it, that the excessive quickness is accompanied by a correspondingly large number of errors. Certainly it would seem from an inspection of the curves for the other classes of data, that low readings are attended by emotional states of a negative tone, as shown by the various deportmental excesses. This general tendency to feel out of sorts may be recognized by the bank clerks as one necessitating extra care in the prevention of inexactness in computation: as days on which the work has to be gone over twice in order to make certain of it, and so, errors corrected on the spot. On the other hand, the other barometrical extreme seems to exist on those days on which we feel perfect masters of ourselves—when we are certain that whatever we do must be right, a fact which would tend to leave uncorrected whatever inaccuracies had been made. If this hypothesis be true, it accounts for the peculiarities of this curve. It must be remembered, however, that conditions of low barometer accompany storms, and since, as will be shown under the proper head, the errors tend to increase upon cloudy days and upon those on which there is precipitation, the fact may be due to the latter condition, though showing upon this curve because of the coincidence of the states considered.

HUMIDITY. This curve (Fig. 22) also shows essential differences from all the other curves for this condition. In them, a general excess of data is indicated for lower humidities and a deficiency for higher ones. With this class, however, except for the very low, we have the relation reversed and have the excess for high readings. Here again the analogy to the death curve, referred to in the discussion of Occurrence, seems to be noticeable on careful analysis, and might again suggest the relation between excessive mental inexactness and depleted vital forces.

There is little question that a general study of climate has demonstrated the latter conditions to be prevalent where humidities are high, especially when accompanied by heat as a prevailing condition.

A person transplanted from a temperate climate, especially if it be a dry one, to a humid tropical region shows permanently the mental characteristics we have discovered here as a concomitant to such conditions temporarily prevailing in the weather. The depleted vitality shows itself as much in an inability to do intensive mental work as in an inability to withstand the ravages of disease, and would give curves based upon the two classes of data, the resemblance which we find between them in this study.

WIND. This curve (Fig. 23) shows in fully as marked a manner as do any for this condition, the gradual decrease of the occurrences considered as the wind increases in violence. We can hardly believe that so regular and marked a tendency as is shown by this curve is due to accident.

It seems to me probable that it is an evidence of the necessity of ventilation on a large scale, such as is caused in our large cities through great movements of the wind. Such movements bring fresh air from the surrounding country to take the place of that which has been deoxygenated through combustion of all sorts, and the effects which we have shown are just what might be expected, for that oxygen is necessary to mental alertness no one can doubt.

CHARACTER OF THE DAY. Here we have a condition diametrically opposed to that of any other class of data (Fig. 24): that is, an excess of occurrences for fair days and a deficiency for cloudy ones.

Since this is the only class of data in which light as affecting the ability to see might influence the result, this fact may be attributed in part at least to a lack of proper illumination. I am inclined to think, however, that this is not so important as it might seem, because of the fact that many of the rooms in which the clerical work of the large banks is done depend very little upon the sun as a source of light. They are, for the most part, so situated as to necessitate the universal use of artificial light. The relation of errors to the character of the day is, however, the one which we should most naturally expect. Replies to the questionaire sent out were unanimous in declaring the belief that mental work was at its best on "fair" ones, the results shown by the curves. Undoubtedly the mind works better under the inspiration of a sunny sky, and unless corrected in the manner suggested in the discussion of Barometer, for this class of data we should expect the results here shown. I have heard, though I have been unable to verify the statement, that the depressing effects of a severe London fog are such that in the Bank of England, certain sets of books, an error in which would prove cumulative and disastrous in its results, are locked up, and the clerks put at work less important during such weather. It is the observation also of the officers of the banks studied that errors increase with unpleasant weather. This fact may be shown in the Occurrence curve for March. The analogy which has been noted between the curve for errors and that for death fails to show itself here and a reference of the former to any indicated condition of vitality seems impossible.

Precipitation. This curve corresponds with that just discussed, in that it indicates an excess of the data studied for stormy days. Whatever was said under the preceding head applies, so far as we know, equally to this, and we shall give it no further discussion.

B. EXPERIMENT IN DISCRIMINATION. The data made use of in this study were kindly furnished by a graduate student in the psychological laboratory of Columbia University. One phase of the problem which he was carrying on was an attempt to discover some law as to the rapidity of formation of muscular habit as well as the rhythm, daily or other, in discrimination time. He made use of blanks, upon which were printed 500 capital

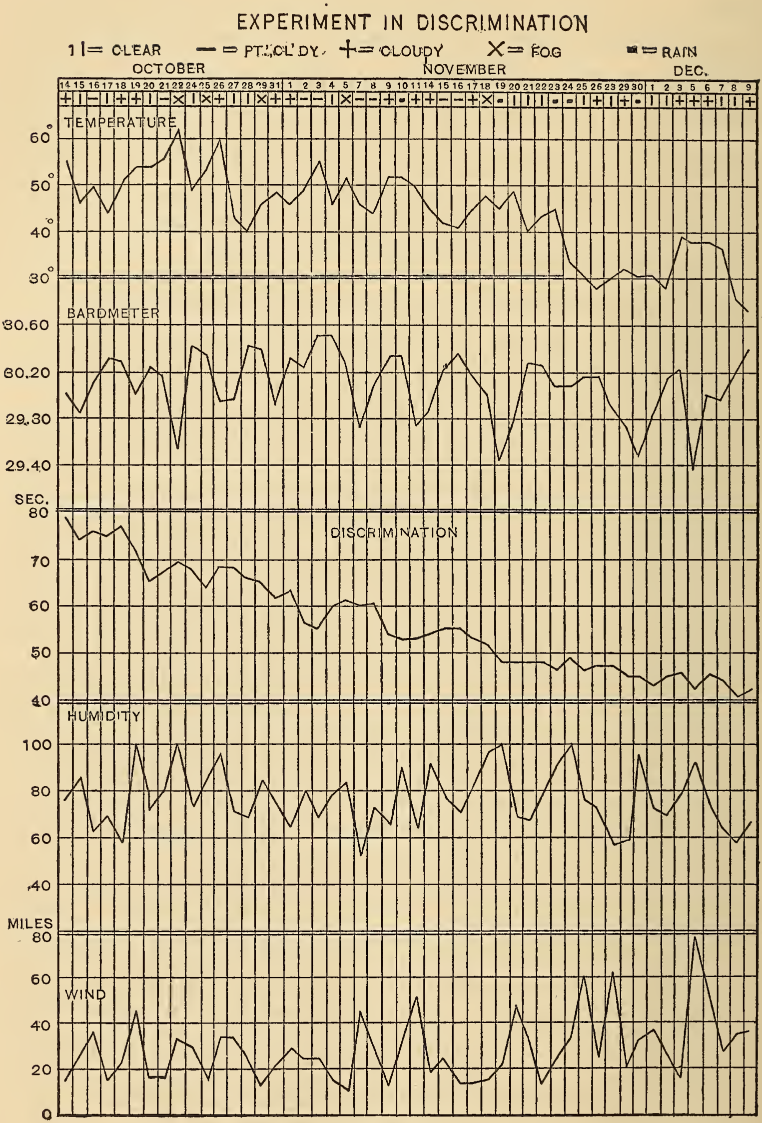
EXPERIMENT IN DISCRIMINATION
| = CLEAR
— = PT. CL'DY
+ = CLOUDY
X = FOG
▪ = RAIN
OCTOBER
NOVEMBER
DEC.
TEMPERATURE
60°
50°
40°
30°
BAROMETER
30.60
30.20
29.30
29.40
SEC.
80
DISCRIMINATION
70
60
50
40
HUMIDITY
100
80
60
40
MILES
80
60
WIND
40
20
0

Figure 50

letters including all those of the alphabet, but among which were 100 A's. His experiment was to cancel with a pencil each of the 100 A's in the least possible time. He did this at several stated times daily for a period of 50 days, carefully noting the time, in seconds and fractions of a second, of each experiment. Although a study of the weather conditions which might possibly affect the rapidity of his work was in no way included in his problem, a regularity of life strictly observed during the period of experimentation tended to eliminate time fluctuations due to accidental causes from his results to such an extent as to make it seem probable that even the limited number of data might be of value from this point of view.

In the tabulation of his results I have used but one of his daily experiments—the first one in the morning, which was, in every case, between 9 and 10 A. M. The time taken for the experiment for each of the fifty days is shown by the curve marked Discrimination, on Figure 50. The decrease in time as the experiments went on is of no importance in our problem: only the fluctuations in time as shown by the ups and downs of the curve being of value.

The meteorological conditions as shown by the other curves are not, as in other classes of data studied, the *means* for the days, but in every case the readings for the 8 A. M. observation. For Wind, the maximum velocity registered since the last observation preceding that of 8 A. M. was used.

TEMPERATURE. The general lowering of this curve, indicating a decrease in temperature during the period of the experiments, makes the curve resemble, in its general direction that of discrimination, but this similarity is purely one of accident due to the time of year, and probably indicates no causal relation between the two.

The discrimination curve would undoubtedly have descended, even if the experiments had been carried on in the spring. A comparison of maximum and minimum *times,* as shown by the fluctuations of the Discrimination curve, with those of temperature seems to show very little constant relation between the two, although with the exception of the days October 14, 22, and 26, November 3 and 5, and December 3 and 5, it would seem as if an increase in temperature was accompanied by a decrease in the time of the experiment. For November 31, December 3, 9, 10, 11, 18, 20, and 23, and December 5 the temperature is shown to be above the average for that stage of the experiments, while discrimination time is below, and for November 24, 27, and 28, December 1, 4, 7, 8, 14, 15, 16, and 26, and December 2 and 9 the reverse relation of the curves obtains. We recognize fully that in this experiment we have too few data to draw any valid conclusions and shall simply present the facts as the curves indicate them, without extended remarks.

Barometer. Inspection would seem to indicate the same general relations between this curve and that of Discrimination as was shown by temperature: that is, high barometer, small discrimination time and the reverse. Although there are some exceptions to this, the relation quite generally exists. The curves show that on October 20, 24, and 25, November 3, 9, 10, and 25, and December 8 and 9 the barometer was above its average, while the time of discrimination was below, and on October 22, 25, and 26 and November 7, 14, and 24 the reverse was true. A comparison of the general coincidence with the opposition of these curves shows fifteen days on which the condition of affairs above stated plainly exists; to five when the opposite was shown.

Reference to other figures which show the curves for various classes of data under varying barometrical conditions indicate that for high readings there is a general deficiency of data of all kinds except errors in banks. Since, however, this is the only class resembling closely the one under consideration, in that it has to do with mental clearness, a comparison may be at least suggestive. If accidents have not affected our conclusions, we have demonstrated, for higher barometrical conditions, both an excess of errors in banks, and a minimum of time required to perform the problem in discrimination. These two facts would, however, seem to be contradictory.

Humidity. This curve taken by itself shows practically nothing. Of the marked fluctuations of the discrimination curve, all are accompanied by a similar fluctuation in that of Humidity and 13 by an opposing one. Probably this indicates no appreciable causal relation and will be only incidentally mentioned in discussing the aggregate conditions for the day.

Wind. This curve is about as barren of results as the preceding. It shows all fluctuations opposing those of discrimination to 8 resembling it in a general way. This difference, however, seems insufficient to warrant any generalization.

Character of the Day. The conditions indicated at the top of the chart for each day is that of the 8 a. m. observation. We have 15 fair, 9 part cloudy, 16 cloudy, 5 foggy, 5 rainy, or 3 per cent. fair, 18 per cent. part cloudy, 32 per cent. cloudy, 10 per cent. foggy, 10 per cent. rainy.

An inspection of the Discrimination curves shows 14 days (October 15, 20, 25, and 31, November 2, 3, 9, 10, 11, 19, 23, and 25, and December 1 and 5) upon which there was a marked lessening of time compared with the previous day, or the average for the period immediately preceding, and 11 days (October 18, 22, and 26, November 1, 4, 5, 15, 16, and 24, and December 2, 3, and 6) when there is shown a noticeably increased time required to perform the experiment. But of the "quick" days, 4 (29%) were fair, 2 (14%) part cloudy, 5 (36%) cloudy, 1 (7%) foggy, and 3 (21%) rainy, and of the "slow" days 2 (18%) were fair, 2 (18%) part cloudy, 5 (45%) cloudy, 2 (18%) foggy, and 1 (9%) rainy.

These numbers, reduced to percentages of the whole number of each class considered, and these referred to the percentages of normal occurrence given above considered as Expectancy, after the manner of the other charts of this problem, give the following:

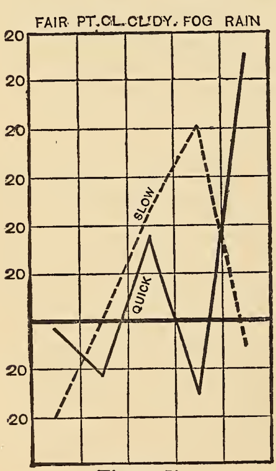

Figure 51

At first sight, the curves seem contradictory; but we must have in mind that but one-half of the fifty days through which the experiments were continued are represented, the other half not having shown any abnormality by the discrimination curve.

Of "quick" days we find a deficiency (*i. e.*, less than are "Expected") for fair, partly cloudy and foggy days, and an excess for cloudy and rainy days (for the latter, of 110 per cent.). Of "slow" days, we find a deficiency for fair and rainy days, the expected number for partly cloudy and an excess for cloudy and foggy ones, the maximum being for the foggy.

For those conditions for which both curves show a deficiency (fair and partly cloudy) we must conclude the days were among those which were not considered.

An attempt to isolate those days upon which many of the meteorological conditions were unusual and to study the combined effects, is of interest. October 22 was of such a character; wind, humidity and temperature were unusually high and barometer correspondingly low. Its effect seemed to be an increase in time of discrimination. On the 26th we have a similar day with similar result. On November 19, a day somewhat similar except for a deficiency in wind, shows an opposite effect upon the mental activity. December 5, a day showing a velocity of wind approximating a hurricane, an excessive humidity and temperature and the lowest barometer of the period studied, in fact, a most abnormal day, shows a very quick discriminative test.

Summary. Clerical errors were to be found generally excessive during the warmer, and deficient during the colder months, with some exceptions noted; but slightly affected by changes in temperature except for a marked increase in number for great heat; of less than normal prevalence for low, and more for moderate readings of the barometer; generally deficient for slight humidities, and excessive for great. They decrease slightly as the wind increases; and are excessive for cloudy, wet days.

Discrimination was quicker when the temperature was relatively high; was quick when atmospheric pressure was relatively great; was little influenced by humidity or wind; was quick upon cloudy, wet days.

CHAPTER XIV

A SUMMARY OF WEATHER EFFECTS

I shall present no new facts in this chapter, but shall through a summarization of the effects of each meteorological condition upon all the classes of data studied, attempt to make somewhat plainer their peculiar effects. The preceding chapters have been essentially topical, each treating of some particular phase of human conduct or activity, and each stating somewhat fully the seeming effect of different weather states upon that particular phase. These effects, however, differ materially for the various classes of data, though even a most careful study would probably fail to impress those differences upon the memory, unless they were more logically and concisely stated than was possible in a topical discussion. The differences in influence make it impossible to answer with exactness the question which I have been asked over and over again as to what the effects of any particular meteorological condition are upon people as a class, though by recourse to a simple classification it may be answered approximately.

Occurrence. Generally speaking the colder months are periods of quiescence for the activities studied. With the exception of sickness, death, and drunkenness, the year begins in every case with deficiencies in occurrence. For these three, excesses are shown. As the months progress, a somewhat rapid increase in prevalence is shown for the entire group which began below the normal, usually culminating in the hottest period of the year, and gradually falling to its close. Exceptions to this may be noted within the group; suicide, insanity and misconduct in the penitentiary reaching the maximum in the late spring or early summer, and declining somewhat during the heated period.

The greatest excess for the hot months is shown for arrests for assault and battery, which, in the case of males, varies almost exactly with the mean temperature of the months. With the school children, for the first and last month of the school year, which are the hottest, the best of conduct is indicated, though reasons quite other than those of the weather are probably the cause (see page 113).

With the other classes of data which showed excesses for January,—sickness, death, and drunkenness,—the annual distribution is quite the reverse of what it is for that just considered. Sickness and drunkenness present almost as perfect and regular a decrease for the summer months as those did an increase. It is, too, rather interesting and suggestive that these go together. With the death rate, there is shown a decrease for the early summer and the fall months, with a very marked increase for the period of greatest heat. So far, then, as the effects of different seasons is concerned, we have two groups of data; one, comprising sickness, death, and drunkenness, which is generally excessive during the colder months; a second, comprising all the rest, which is deficient in occurrence at that time of year.

Temperature. An inspection of the figures showing the effects of heat and cold upon the various activities discussed in the previous chapters seems to point to a somewhat similar grouping to that made in the last discussion. For three classes of data are excesses shown upon the lower end of the temperature scale; drunkenness, which is unquestionable; sickness, which is even more pronounced; and suicide, though the number of data for the 0-5 degrees temperature group was so small as to give the reading for that group but little weight. Still, it seems natural that self-destruction of the so-called "rational" type should be prevalent under conditions of intense cold. Arrests for insanity are also shown to be excessive for the lowest group, but I attach no weight to that fact, the general upward trend of the curve leading me to believe that the fluctuation is accidental to the problem, especially since a still lower temperature group than that shown (not plotted because of the fewness of data upon which it is was based) showed deficiencies. Errors in banks are also slightly above the normal for the most intense cold, and the deportment in the penitentiary is so, near the lower end of the curve, though not at its beginning. The death rate for the two lowest groups is neither plus nor minus, though drawn as if slightly minus. For all the other classes of data, occurrence is plainly below the normal for the lower temperatures, either gradually increasing with the temperature (assault), or seemingly unaffected by it for a considerable space (insane), then showing a very rapid increase beginning at from 70 to 80 degrees, which is again followed in the case of assault by a drop for the very highest temperatures. With the deportment in the public schools this drop comes at a lower temperature, but is fully discussed upon page 116. The relation between the curves for the different sexes, where they were studied separately (as in the case of assault and insane) leads to the conclusion that the effect of heat upon females is greater than upon males. This is shown both in an increased pugnacity and in a greater mental unbalancing. Especially is this noticeable for assault. Starting at the lower temperatures with a deficiency much greater than that for males, the curve indicates a somewhat gradual increase to an excess of 100 per cent., or double the expected number for the temperature groups 80 to 85 degrees, at which point it drops 33 per cent. The curve for males shows neither extreme so far from expectancy, nor is the drop at the end so marked. This sudden falling off of assaults for the most excessive heat is a very interesting fact; but since conclusions are drawn from it which are discussed in the next chapter, I merely call attention to it here. The greater sensitiveness of woman to weather conditions was noted by at least one of the teachers in discussing the answers to the questionaire. The physiological conditions which bring about an unequal demand, in point of time, upon the vital energy of the sex, are undoubtedly its causes. Without question, during periods when this demand is greatest, the emotions are less stable and the weather effects much greater than for periods when those demands are less.

Briefly stated, then, we have two opposite effects from heat: first, upon sickness and drunkenness, which vary inversely as the temperature; and second upon crime and insanity, which vary directly with it. Between these two we have the classes of data which are studied for indoor conditions (death, deportment in the schools and penitentiary, errors in banks) and which would not feel the full force of temperatures as registered by the Weather Bureau, though they all show a marked influence from extreme heat; and lastly, suicide, which shows peculiarities all its own, though none the less interesting.

BAROMETER. There is a greater resemblance between the effects upon the different classes of data studied, of those meteorological conditions of which the barometer is the measure, than of those of any other weather state. With the exception of the curves for sickness, which vary only in one particular from the type; for drunkenness, which differs very materially; for suicide, which is also somewhat at variance; and that for clerical errors; the curves might be superposed, and, save for minor fluctuations, would practically coincide. Death was not, however, studied for this condition, owing to a difficulty in getting the record for the years 1886-7, or it is possible we might find a somewhat greater divergence. The fact disclosed is, that—save for the exceptions cited—there is an excess for all occurrences for relatively low readings, and a corresponding deficiency for high ones. As has been stated elsewhere (Chapter VII.), it does not seem probable that the definite state of the atmosphere revealed by the barometer is itself the direct cause of the variation, so much as other weather states which are their concomitants. Since, however, the other curves so nearly resemble that for deportment in the schools, which was somewhat fully discussed in the chapter just referred to, we need mention here only the divergencies.

That for sickness shows the same general excess for low pressure of the atmosphere, together with a similar though unusual one for high readings. Drunkenness also exhibits a similar though more pronounced increase for great pressures, while the divergency of suicide from the type is through a deficiency for low barometrical conditions. The curve for errors in banks shows that there seems to be no general effect of the different barometric conditions upon their occurrence, although errors seem to be slightly less in number for conditions of low barometer than for high. As a basis for its consideration, we must conclude that the other curves indicate a less full control of the emotions for low barometers than for high. Reasoning from this hypothesis, my conclusion is that the errors studied are more frequent when mental —or at least emotional—states are under most perfect control. This, however, seems contrary to all opinions based upon introspection or general observation, and leads to an analysis of the conditions under which the errors were made in search for any other hypothesis to explain the facts. A possible one is found as a result of conference with the offending individuals themselves. It is that on some days they seem to feel a confidence in themselves which leads them to pass off work as perfect at the first attempt; a computation is rapidly made, or a column of figures added, and another piece of work undertaken, without a second thought as to the correctness of either. This is the case on days when they feel at their *best*. On other days a greater possibility of errors seems to be recognized, based upon the way they feel, and greater care is taken with each process, or the work is even done over again in order to prevent errors which are thought to be probable in their existing mental state. If these facts be true, the result would be just what we find for our curve. An increased tendency inhibited with more than a compensating care would give a negative result; yet in this case our results are not those of weather effects upon mental states, except as those effects are especially compensated for, and we cannot consider the readings of this curve as normal for the influence of the barometer upon intellectual activities. It is quite probable that, at least for the teachers in the schools, there is a similar restraint based upon recognized tendencies, which would serve to negative the tabulated effects of the weather upon the conduct. In fact, if this study is to be of any practical value to them, it can be so only in pointing out the conditions under which such restraint must be exercised, as well as allowances made for others.

To summarize still more briefly: Atmospheric conditions which are registered by a low barometer are productive of the various manifestations of active disorder tabulated under the heads, crime, deportment, and insanity. Sickness also seems to be increased by the same condition, while suicide is very excessive during atmospheric pressure somewhat below the normal. On the other hand, drunkenness is less prevalent under such conditions; and attention, as indicated by perfection of mental computations, is either more perfect, or greater precaution is taken to guard against error.

Humidity. A prevailing type is readily discernible upon inspection of the various curves for humidity. It shows an excess of the occurrences studied, for dry atmospheric conditions—sometimes, as is the case with the Denver studies, a very marked excess—and a corresponding deficiency for a high degree of saturation. Corresponding to this type we find the curves for deportment in the public schools and penitentiary, assault and battery, and arrests for the insane, all these curves resembling each other to a marked extent. Opposed to them we find sickness, drunkenness and clerical errors showing the reverse effect, all being more prevalent when the humidity is great. The suicide curve resembles in a measure both types, since it rises above the normal at both extremes; the death rate seems to be unaffected by varying conditions of atmospheric moisture except in the case of an increase for the group of greatest saturation.

It will be noticed that nearly all the curves which show a general decline with increasing humidity, make a somewhat sudden drop for the highest groups. Nor can this drop be accidental, too large a percentage of the data occurring in the 95-100 groups to make this probable. It must, seemingly, be due to weather effects. In the light of facts demonstrated in other chapters it would seem as if the condition of humidity brought about the results indicated, through its effect upon the reserve energy. An excess of energy is required to produce the abnormalities in conduct treated in the first class—that is, assault, misdemeanor in the penitentiary, and, perhaps, the active symptoms of insanity; while death, suicide and mental inexactness are results of the deficient state. Yet both the chilly, damp days of winter and the muggy, sticky days of summer have high humidities. This fact led me to question whether an emotionally quieting effect might not accompany the former, and one of a reverse influence, the latter; yet the two so negative each other's effects when taken together as to fail to represent fairly the condition. Figure 52 was constructed as the result of attempts to show the effect of humidity with an accompaniment of high temperatures only. It was made for male assault and death as the two classes having the largest number of data, and consequently less liable to be affected by accident. In its preparation the effect of humidity upon their occurrence

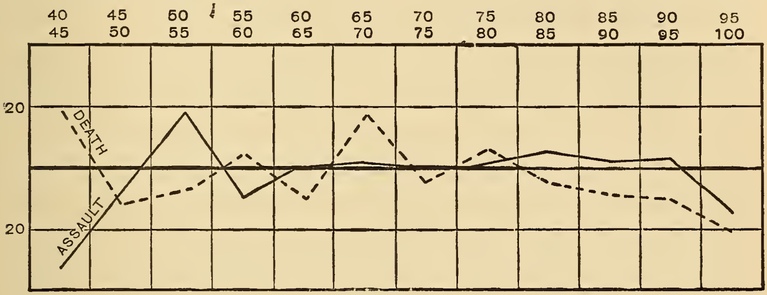

Figure 52

for days when the temperature was 70° or over was studied; in other words, an attempt was made to find whether humid, hot days, or dry, hot days were the more productive of these results. We see that even for those days whose temperature was within an arbitrary group of 70° to 95° the varying conditions of humidity had but a comparatively unimportant effect, and that of a character which we should hardly expect. If the curves show any general tendency, it is one of decrease of occurrence for high humidities, for both curves show a somewhat marked deficiency for the highest group.

However, I do not consider these curves of much value, for two reasons. First, the number of days upon which they are based is too small. There is an average of only 61 days each year having a mean temperature above 70, and this gave us but 122 for the Death curve and only two each for the humidity groups 95-100, 40-45, and 45-50, and but eight for those of 85-90 and 90-95.

This number is altogether inadequate, as accidents might easily affect the results. Second, the excessively hot days of our extended temperature groups were seldom those of the highest humidity. When those two conditions do come together the results are known to be very disastrous; but for the period studied the combination occurred but seldom. This fact could not help affecting our results very materially. Our temperature curves have shown the great effect of high temperature, and this means that on the hottest days would be expected the greatest number of assaults and deaths. If, however, those hottest days were, as seems to have been the case, almost universally days of low humidity, we might have the result shown in Figure 7, or even a more marked excess for lower humidities. This source of error might have been lessened by making use of a smaller temperature group; but this would have materially cut down the number of data, and so made prominent the other horn of our dilemma.

To return again to the general curves. The slight excess for lower humidities may, perhaps, be ascribed to the increased electrical potential for such conditions. Although this electrical state has been described (page 127) as existing at every point of the earth's surface and for any climate, it has not been found to be very great except for lowest humidities that are common for New York (see Denver curve), at which point it makes a great jump. The fact has not been fully determined, although it is quite probable, that the potential bears a somewhat constant relation in inverse ratio to the humidity. If this be true, our excess of data shown for low humidities may be accounted for as was the very marked one for the Denver school children under still lower conditions.

The resemblance between the curve for sickness as shown by the applicants for aid at the hospital, and that for drunkenness, coupled as we have found them for so many of the meteorological conditions in opposition to the others, argues strongly a uniformity of physiological origin and might almost convince us of the truth of the "drunkenness a disease" theory.

The curve showing the prevalence of errors in banks is interesting, because it comprises the only class of data which are based upon intellectual processes pure and simple. The excess for the lowest humidities might indicate, if it be not due to accident, that the intellectual balance is more disturbed by the increased electrical potential, than is the emotional. The gradual rise in the curve from the 50-55 to the 95-100 group indicates that the devitalizing effect of increasing conditions of moisture have so exhausted the energy applicable to mental processes as to affect their regularity and perfection. Briefly stated: A dry atmosphere is a stimulant to all forms of active disorder and to suicide: is an enemy to intoxication and mental inexactness.

Wind. No one of the meteorological conditions studied, more plainly differentiates the various classes of data into contrasting groups than does the wind, and no conditions present more anomalous and unexpected effects. Particularly is this true for atmospheric movements of less than 100 miles for the twenty-four hours, which I have characterized as calms. In order to make plain the seeming effects of such conditions I have inserted the following table:

TABLE SHOWING PREVALENCE DURING CALMS OF PHENOMENA STUDIED

(One hundred per cent. equals the normal or expected number)

Assault and battery (male)	89	per cent	Penitentiary: deportment.	80	per cent
" " " (female)	45	"	Death	104	"
Drunkenness (male)	78	"	Policemen off duty	105	"
Insanity (male)	67	"	Banks, errors in	105	"
Insanity (female)	34	"	Sickness (hospital)	114	"
Suicide	62	"	Schools, absences	314	"
Schools: deportment	50	"			

As will be seen, misconduct in the public schools was only one-half the normal prevalence upon calm days. The number of males arrested for assault and battery upon such days was 89% of the normal; of females for the same crime, 45% of the normal; of males for drunkenness, 78%; of males for insanity, 67%; of females for insanity, 34%; of cases of suicide, 62%. The figures show that there was a deficiency in the occurrence of all these crimes, the magnitude of which may be computed in each case by subtracting the percentage of occurrence from 100%, which is expectancy. These classes of data constitute the first general group, so far as wind effects are concerned, comprising those activities which are deficient for calms. With the death rate, the next in the list, we have the begininng of the opposing group, mortality being above the normal (104%), as is the case with each of the other classes of data in this list, the percentage of excess rapidly increasing until we find more than three times the normal number of absentees from school.

The facts so far given do not show whether the change with an increase of wind was a gradual one or not. The most striking thing about the curves upon which it is based is the sudden change which takes place in the occurrence of nearly all the activities (or cessation of activity in the case of death) with a slight increase in atmospheric movement. In the case of arrests for assault and battery and for insanity (both males and females), and of misdeeds in the penitentiary, all of which had shown deficiencies for calms—and some of them very large ones—excesses were shown for wind movements between 100 and 150 miles per day, while misdemeanors in the schools were also above the normal before a movement of 200 miles had been reached. On the other hand, policemen off duty, sickness, and death, both of which had been excessive in number during calms, took a sudden drop as the wind rose, and showed deficiencies for the next group (100-150 miles). Suicide, drunkenness and clerical errors alone showed gradual changes with the wind. The appearance of the curves as a whole is such as to lead me to place calms in a class by themselves as far as wind influences are concerned. High winds seem to have an influence peculiarly their own, gradually merging into that characteristic of moderate and slight movements, but when the aerial stagnation of 100 miles per day or less is reached a sudden change takes place, and certain phenomena suddenly increase in numbers while others drop almost to a vanishing point. Which are the ones in excess? Absence from school, absence from police duty, clerical errors, sickness and death. But absence from school means sickness, absence from duty the same, clerical errors the same in milder forms, and death the same at its maximum.

It would seem to be true that: *during calms, those life phenomena which are due to depleted vitality are excessive.* But let us return to those phenomena which are deficient in occurrence during calms. They were misdemeanors in public schools and penitentiary, cases of assault and battery, insanity, drunkenness, and suicide. To analyze each briefly: in the public schools, sins of commission, rather than sins of omission, are usually the occasion of bad marks in deportment. It is usually the active, energetic boy, the one with vitality to spare, who gets the demerits. The anaemic youngster may never stand at the head of his class, but he is very likely to delight his fond mamma with a mark of 100 in deportment. If that be so, and I speak with authority upon this point, if upon no other, disorder in the school room is an active thing, and an evidence of excessive vitality. With the penitentiary inmate I have had less experience, but upon *a priori* grounds would argue that what is true for the child in question of deportment would not be radically different for the adult. In fact, the wardens in charge, upon being questioned on the matter, gave it as their opinion that the prevalence of disorder bore a pretty close relation to physical health, varying directly with it; that order was only observed through evidence of superior force on their part; that a sick person was always a good one, but that with return to health, conditions were frequently very different. We may, then, conclude that in the penitentiary misdemeanors are evidences of excessive vitality.

With persons arrested for the crime of assault and battery the same is, I believe, demonstrably true. One might feel like fighting, and perhaps more frequently does feel so, when possessed of "that tired feeling" which is the fortune of patent medicine venders, but to *feel* like fighting without doing so, never brought a man before the police judge for the crime which we are considering.

There must be both the inclination and the consciousness of strength to back it up before one would be likely to figure in this class of data.

In the case of the next class, that of arrests for insanity, we shall take the word of the psychiatrist that acute mania increases with any condition which tends to augment the output of nervous energy. The daily fluctuations in strength which all have experienced are not so much those of physical, as of nervous energy, if the distinction may be made, and with persons having tendencies to mania the results would be those which our records showed.

Drunkenness and suicide are not so plainly manifestations of superabundance of vitality, but with these possible exceptions we can say *that during calms those life phenomena which are due to excessive vitality are deficient in number.* If these theses have been sufficiently defended, and figures are not in existence with which to refute them, the next logical question would be, "Why?"

Two hypotheses may, I believe, be presented in answer. The first is based upon the general facts bearing upon ventilation, and the second upon those of atmospheric electricity see page 132). The first would only be applicable to the conditions of large cities—and I will again call attention to the fact that all data of the present problem were for New York City—while the second would be valid for any spot on the earth's surface. In discussing the first I would call attention to the fact that combustion of any sort, whether within the lungs of animal organisms or in the ordinary processes of burning, depletes the air of its oxygen and surcharges it with carbonic acid gas. If the normal proportion of oxygen is to be maintained in the immediate vicinity of such combustion, fresh air must by some means be brought in to take the place of that, the normal mixture of which has been disturbed. We are quite familiar with these facts in their bearing upon the ventilation of buildings, but there is no difference except that of magnitude between a building in which the air is being robbed of its oxygen through combustion, and a city in which the same process is going on. Three million animal organisms (not all human) and half as many more fires, all without adequate vegetable organisms to reverse the process, should, we would argue, make tremendous inroads upon the atmospheric stock of oxygen.

Except for the Colorado altitudes, the direct influence of high winds upon the activities which we have studied is hardly so great as might be expected. With the exception of suicide, most of them are influenced less than by differences in atmospheric pressure as revealed by the barometer, though the latter are hardly appreciable to the senses. The general effect of violent winds is to increase the prevalence of our data, though in the case of deportment in the public schools of New York City the reverse is true. The death rate shows a rise only for virtual hurricanes, no effect being noticeable until velocities averaging twenty-five miles per hour for the entire day are reached.

Character of the Day and Precipitation. The effects of days of different characters, according to the nomenclature of the Weather Bureau, seem contrary to general opinion upon the matter. With the sole exception of errors in banks, death, and sickness there were more occurrences of every class studied for fair days than for cloudy days. In some cases, however, there were more for those days characterized as partly cloudy than for fair. The curves for Precipitation, with the exceptions noted, also show universal excesses for those days on which there was no rain or snow. Considering the greater excuse one has to be out of sorts on rainy or cloudy days, as when the pleasure of a picnic or an excursion into the country has to be foregone because of unpropitious weather, this fact is quite surprising. Even the suicide chooses the fair day for self-annihilation (except in the Denver climate), and seems to have a very marked aversion to rainy weather. The relation between the curve for Character of the Day and that for Precipitation for the same class of data throws additional light upon the exact kind of day chosen. Attention has been called to the fact that not all cloudy days are rainy days; and that not all those upon which there is precipitation are necessarily characterized as cloudy, or even as partly cloudy. Comparing the relative deficiencies of a given class of data for cloudy days and for those showing precipitation, we can discuss the effects of those gloomy days which we all know so well, when the sky is overcast or perhaps the atmosphere full of fog, but on which no rain falls. As an example, we may compare the curves for suicide under the two conditions, and we see that for cloudy days there is shown a deficiency of 1 per cent., while rainy days indicate one of 14 per cent. This means that although the number for both conditions was less than expectancy, there were relatively more suicides for cloudy than for rainy days. Now it would be safe to say that nearly all the rainy days were characterized as cloudy, but that the former made up only a portion of the latter.

The remainder, which would be cloudy, but not rainy, would have to account for the difference of 13 per cent. shown by the two curves. This must mean that of the cloudy days, those which were without rain were accompanied by the greater number of suicides.

All the sets of curves may be considered in the same way; and, as a matter of fact, nearly all would show the same effect for days overcast, yet without rain. I recognize a possible fallacy in this argument, from the fact that in each of the curves for character of the day three conditions are shown, while for precipitation there are but two; yet for many of the classes of data the number for at least one of the three characterizations of the day is so near the *expectancy* that it can hardly have much effect upon the result.

The question might be asked as to the effect of foggy days. No special study has been made of them, but an analysis of the curves under consideration might in part answer it. Days upon which there is fog might come under any one of the five conditions of the two curves; if they were accompanied by no precipitation, they would be characterized as "fair," "partly cloudy," "or "cloudy," according to the duration of the fog. Most of the foggy days in New York, however, are accompanied by more or less precipitation, and I am inclined to think that those portions of the two curves under "cloudy," and ".01 inch" would include a great majority of them. It would seem that such were accompanied by deficiencies in occurrence in all the data studied except errors in banks, and perhaps death, which slightly contradicts itself in this respect.

Upon the same theory, which has been stated in other paragraphs, we should say that such days are devitalizing. There are reasons for believing that they are so from a mere study of the chemistry of the atmosphere at such times. In the paper referred to upon page 152, a further analysis of the air is given for clear and for foggy days. The figures there show that under the latter condition the volume of carbon dioxide is from two to three times what it is under clear skies, the volume increasing in proportion to the duration of the fog. We found that when a similar excess of this poison existed in the atmosphere because of lack of wind to carry it away, all the curves bore the same relation to the *expectancy,* and each is corroborative of the other's evidence that devitalizing atmospheric conditions, whatever may be their effect upon the emotions, are inhibitive of action.

CHAPTER XV

CONCLUSION

Analysis of the facts presented in the preceding chapter of this volume seems to warrant a number of conclusions which I state in all modesty, fully appreciating the fact that there are many possible phases of the problem which have not been touched upon, and that a further exploitation of the field may prove any, or all of them, untenable.

First: *Varying meteorological conditions affect directly, though in different ways, the metabolism of life.* By "metabolism of life" I mean those processes of oxidation, either within the lungs on other tissues of the body, which are the chemical basis of life as we know it.

This conclusion, it seems to me, has been fully proved for any variation in the prevailing sick list or the death rate ascribable to the weather, and I have shown that such are directly in support of it. Sickness and death are, without doubt, due to some pathological condition of the body, and any pathological condition is but a derangement of its metabolic processes. Even if this derangement may be due immediately to the action of some germ, any variation in the activity of the processes which are shown to be closely related to differing meteorological conditions must be attributed either to the effects of these conditions upon the germ, or upon the organism supporting it. Since germs have been proved to be such hardy little creatures, we are forced to suppose the effects to be upon the organism. For whatever meteorological conditions then, we find a well-marked excess or deficiency in the death rate, or even in the attendance at the public schools—if our supposition was correct that this was influenced by health—we may conclude that an effect upon the metabolic processes of life is indicated. Such an effect may be either favorable or unfavorable to health. Favorable conditions would be shown by a decrease in sickness and death; unfavorable conditions by the reverse. A study of the curves illustrative of sickness and death shows that generally low conditions of temperature, humidity and wind are favorable, as shown by a deficiency, while partly cloudy and dry days seem to be somewhat so, if we make allowance for the direct effect of such conditions upon the ability of the people to get about. On the contrary, high temperature and humidity, and moderately high winds, together with rainy, fair and cloudy days, are somewhat unfavorable. These conditions seem so different, basing our judgment upon general experiences, as to lead to a further analysis of the unfavorable conditions. Some of them seem to be of such a character as to accelerate the vital processes of oxidation, and others to retard them. For want of better terms, I shall call the former *anabolic,* the latter *katabolic,* conditions. High temperature, high winds (better ventilation), fair days with low humidities as an accompaniment, are *anabolic;* while low temperatures, high barometric conditions, calms, rainy and cloudy days and high humidities, because of their opposite characteristics, are *katabolic.* Now it may be seen that health, which means a metabolism of the definite rapidity demanded by nature, as brought about by a long series of natural selections, may be affected disastrously either by an acceleration or by a retardation of those processes. A fire may go out either from lack of fuel (too rapid oxidation) or from lack of draft (too little oxygen). The same fact is shown in a definite manner by our study for the metabolic processes of life. Those conditions which I have termed *anabolic* produce too rapid a metabolism to be borne by the weakened organism, while the *katabolic* so lessen the production of available energy as to reduce its quantity below the minimum required for life or health. A study of the various curves of the death rates and school attendance shows that, generally speaking, the so-called *katabolic* conditions are the vitally depleting ones. The marked exception is found in the showing for high temperature (mentioned later in this section); but the fact is plainly true for calms, high humidities, low barometric conditions, and to an extent for cloudy and rainy days. These conditions have all been classified as *katabolic.* For them the death rate is high and sickness prevalent. This is not strictly true for the death rate upon rainy days, when compared with *expectancy,* but taking the curves of conduct as our basis of comparison, rainy days showed a very marked excess. These relations, considered in the light of our already defined use of the term *katabolic* as applied to meteorological conditions, show that vitality is depleted and that the spark of life goes out because of the retardation of the metabolic processes, rather than because of an acceleration of them to an extent that depletes the cell structure. If an animal were placed in an atmosphere of pure oxygen, death would ensue from the latter cause; such a condition would be anabolic in the extreme. Although the variations in oxygen, the life-giving element of our atmospheric air, and of carbon dioxide, the death-dealing component, are not great, still they are of sufficient magnitude to be effective, and we must conclude that the vital fires are quenched for want of the supporting medium, rather than that they burn out from lack of fuel. That they are affected to a marked extent by meteorological conditions cannot, in the light of what has been said, be doubted.

My use of the terms *anabolic* and *katabolic* is open to criticism, and I should not attempt to uphold it, except that there seem to be no other available terms, and with the exact definition which I have given of their use in this study, a definite conception may be imparted without circumlocution.

Second: *The "reserve energy" capable of being utilized for intellectual processes and activities other than those of the vital organs is effected most by meteorological changes.* The sum total of available energy of any living organism would consist of that which is being used by, and is necessary to, the vital processes of living, plus a remainder, which may be utilized for intellectual processes and the motor activities accidental to life. The latter I have designated as *reserve energy.*

If my first conclusion be valid, that the metabolism of life is affected by the weather states, it must follow that the sum total of energy resulting from such processes is also affected. But the sum total of available energy consists of that which is absolutely essential to the more vital activities of life—respiration, circulation, digestion, assimilation and excretion—plus the reserve energy: the residuum for the higher activities of life, after those of mere existence are satisfied. It is this that we find most emphatically testifying to the effect of weather changes. When we find an effect of a given magnitude upon health or the death rate, we find one many times greater upon the emotions, as shown by the deportment. It is true that we have no common unit of measure for physical and mental variations, yet a comparison of the curves as a whole proves beyond a doubt that, based upon any available criterion, this is true. From biological analogy we should expect it to be so. Phylogenetically, the energy of vital process is the older: in fact, as old as the animal kingdom itself, and the earliest race acquisitions which we possess are not vulnerable to the common weapon of environment. The reserve energy is, however, a later acquisition, common only with that individual adaptation to the environment which we call education. It is interesting in its relation to the life history of the individual, as it is to the race history of an individual. During the period of growth it seems to be universally excessive for persons in good health. It shows itself in the play and spontaneous activities of childhood, and the athletic sports and intellectual development of youth. During the period of maturity it has a strong balance in its favor, unless depleted by special demands made upon it; while old age gradually lessens its quantity, till the sum total of bodily energy only equals that being used in life processes. Under such conditions, any extra demand necessitates a draft upon the latter, and if it be too heavy, the whole process stops. But beside the life rhythm in the reserve energy, there are many others due to the accidental conditions of bodily health. We all recognize them, and they need not be discussed here. The rhythm which we hope to demonstrate is one of less marked fluctuation; one not of health and disease in the ordinarily accepted sense of the terms, but one of exhilaration and depression, of activity and lassitude, of good spirits and poor. Not these conditions as the ascribable effects of actual bodily disease, but coming whence we know not, and why we cannot tell. This rhythm it is that the subtle agency of weather seems to affect. As a consequence of our method of reasoning, those definite meteorological conditions which were designated in the discussion of the first thesis as *anabolic* would be those which in this varying weather rhythm would produce the greatest reserve energy, the reason being that for them the metabolic processes are increased. There seems to be one marked exception to this generation of energy and the demands made upon it by the vital processes; and that is, for excessively high temperatures. For such conditions the vital demand exceeds the production, and the reserve is depleted or exhausted. This is shown by the great increase in death and the sudden decrease in assault shown for the highest groups, but especially by the curves upon Figure 14. The latter show no increase in assault for the highest temperatures of July and August, while the actually cooler days of April and October, though the hottest for those months, show marked effects. It seems to me probable that the low vital reserve for excessively high temperatures may be due in part at least to the increased energy required by the accelerated secretion of the glands belonging to the excretory system. Large amounts of perspiration can be produced only at the expense of some form of energy, and since that is a process certainly abnormal at such times, it may be something of a drain upon vitality. This theory is, perhaps, corroborated by the etiology of sunstroke, which occurs only when perspiration has ceased, at which time the high bodily temperature and the activity of the metabolic process may mean more than mere failure to reduce the former by evaporation. Yet the magnitude of this effect of great heat upon health is exceptional. The curves as a whole give the preponderance of weather effects to those activities which are the result of reserve energy, rather than the more fundamental energy of life.

Third: *The quality of the emotional state is plainly influenced by the weather states.* This conclusion is supported in part through the memory of our own experiences and by our observation of others. We are all conscious of the exhilarating effects of some kinds of weather which cast a roseate hue over the whole horizon, and of others which paint it with sombre tints. Literature has fully recognized this influence, and nothing that any empirical study might show could disabuse us of our belief. But so far as the present study is concerned, the evidence is all in its favor. One cannot have faith, even in the prevalence of a normal quantum of altruistic feelings at a time when murder, assault and the more trivial evidences of ill-will in school room and prison are nearly doubled, yet that is what we find for some of the weather moods. Nor can we believe, when all of these things are happening together, when everybody is "stirred up," that the weather has nothing to do with it. Admitting, too, that the weather influences the vital energy, we have plenty of sound psychology, arguing that it should be so, for it is a well recognized fact that low vitality—either temporary or long-continued—means low spirits. When the baby is tired or hungry, and both mean the same thing so far as reserve energy is concerned, it is cross, and it is possible that many of us of an older growth would not wish to be analyzed too closely on this point. This conclusion is, however, so self-evident as to need no further argument.

Fourth: *Although meteorological conditions affect the emotional states, which without doubt have weight in the determination of conduct in its broadest sense, it would seem that their effects upon that portion of the reserve energy which is available for action are of the greatest import.* In the discussion of this conclusion we must discover the relation existing between reserve energy and the emotions, for meteorological conditions showing marked excesses or deficiencies of data. A disorderly act of the nature of an assault or misdemeanor in the penitentiary, can occur only at such a time as there may be both energy and inclination or impulse to undertake it. The former must bear some relation to the reserve energy; the latter, to the emotional state, which would at the instant probably be negative in quality. We have traced the relation between the occurrences taken as data of deportment, and the reserve energy; we have stated that—arrived at by introspection and general experience—the days upon which we most often find ourselves "out of sorts" (a negative emotional state) are the hot, humid, cloudy and perhaps rainy ones, some of us reserving the right to be hard to get along with when the wind is high. Such are the days when, all other things being equal, we should be most liable to have trouble with teacher or fellow man, *if the emotional state were the only factor.* But we find that for some at least of these "ugly" days the numbers of misdemeanors alluded to are much below expectancy. Such is the case —*mirabile dictu!*—for the humid, the very windy, the cloudy and the rainy days. We should be at a loss to account for such a showing did not the conclusions from our study of the reserve energy come to our aid; for all the conditions noted, this was found to be very much depleted. This fact is undoubtedly the cause of the deficiencies shown. A most ardent desire to hurt somebody is not very dangerous, if there is nothing to back it up. A most uncomfortable atmosphere might result, and a record of profanity might show some interesting things; but *inclination* alone will at least get no one into the police court. Reserve energy, on the other hand, seems a most dangerous thing to have about, so far as personal conflicts are concerned. With the consciousness of power to maintain one's position, even by strength of arms, the opportunity under the most favorable emotional condition seems likely to arise. At any rate, our curves show the balance in favor of the influence of reserve energy, accompanying the best of spirits, over vital deficiency and most unhappy states of mind. If we could have made this study for Colonial days, and have taken our records from the ducking-stool, the results might have been very different.

Fifth: *Those meteorological conditions which are productive of misconduct in a broad sense of the word, are also productive of health, and mental alertness: as a* *corollary, misconduct is the result of an excess of reserve energy, not directed to some useful purpose.* In the discussion of the first thesis we showed the relation existing between the death rate and the various meteorological conditions studied. In considering the second and fourth we have shown that relation for the data of Conduct. It has been shown; first, that the general effect of conditions which I have designated as *katabolic* has been to increase the death rate.

Second, that the general effect of *anabolic* conditions has been to increase the data of Conduct. There are some exceptions to both these statements, notably that of high temperature upon the death rate, which has been touched upon and hypothetically accounted for; still, as a whole, the statements are valid. Tracing the curve for errors in banks upon the various charts, we are convinced that they more nearly resemble those for death than for Conduct. On the temperature charts all the curves (except that for the school children) show the same general tendencies. On that for humidity the curve for errors in banks closely resembles those for sickness and death, all showing excesses for high humidity in marked contrast to those for Conduct. For wind, it resembles the death rate in showing no deficiency for calm, though for the rest of its course it is more similar to the Conduct curves. For cloudy days it and the death curve are the only ones giving expectancy or more, and for rainy days they are the only ones not showing a marked deficiency. Without discussing this curve further, we assert that its resemblance to that for death is much closer than to those for Conduct. This is, perhaps, only what should have been expected, since in both the intellectual work of the bank clerks and the vital processes of life actual demands upon the reserve energy are made.

The barometric conditions, which have been omitted from the discussion because they were not available in our study of the death rate, show an interesting discrepancy for sickness and errors in bank curves. This can not be interpreted in terms of comparison with anything but the curves for Conduct; still they are perhaps suggestive of the position of that for Death, if it were computed.

Without discussing the Suicide curve in detail, we can say that in many respects it is midway between those for death and conduct in many of its showings. For humidity in particular it closely resembles the former. An analysis of the mental and physical states which would suggest those of a negative quality, coupled with those of a depleted reserve energy. Each of these is the accompaniment preëminently of one of the classes of data which we have been considering; the former of excesses in Conduct, and the latter of death. But their relation to one another in the suicide is the one which we cannot hope to discover in this problem, though the relation of the curves may perhaps throw some little light upon it.

On the whole, it would seemingly be safe to say that of the activities (or cessation of activity) possible to human beings, some are the result of excessive vitality, and others of a deficiency; and that, generally speaking, those misdemeanors which have been classed under our study as those of Conduct are the results of the former, while sickness and death are accompaniments of the latter.

If this be so, and misdemeanors in general are the result of unutilized energy, an interesting, though not by any means a new social and pedagogical problem is suggested. It is well known that crime is excessive during periods of labor depression when large numbers of men are unemployed. But the explanation has usually been an economic one: that poverty, in a sense warranted the extreme measures taken, usually directly or indirectly associated with theft. Or it may have been that the old adage "Satan finds some mischief still, for idle hands to do" has been accepted in excuse. But is this the final word?

And with the school child; have we not here an argument for more work?—not mental work, but good, solid, healthful manual labor or athletics, for of the intellectual sort we have enough already. It is an old cry, but a far cry. Pestalozzi and Froebel both uttered it; but it cannot be repeated too frequently, nor too loudly. The social problem of work as an agent of reform is not an easy one to solve, but with the schools, conditions are more fully under control, and if a football team will take the place of a strap, let us have football or any reasonable substitute, on the prescribed list.

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