twelve inches of rain in the six winter months produce six bushels of wheat per acre, and that for every increase of rainfall of an inch a like increase occurs in the average production of bushels of wheat per acre."

The minimum rainfall is undoubtedly of the greatest importance to agriculturists, and we reproduce here a portion of the map of minimum rainfall. The point at which a region may be classed as arid, and unfit for successful agriculture, is believed by Gen. Greely to be fifteen inches. This amount of annual rainfall is not considered sufficient for all crops, nor on all kinds of soil, but may be assumed as an average. Exact observations upon these points are lacking in the United States; but in Australia, observations and experiments have been made, covering now quite a number of years, on wheat, which may be called a test-crop.

The fact that wheat can be grown without irrigation, in a country where the annual rainfall is less than twenty inches, is evidenced by official statistics from Dakota, which show that wheat is grown by tens of millions of bushels yearly in sections where the rainfall ranges from twenty inches downward. In that region over three million bushels of wheat are now grown annually in counties where the rainfall ranges from fifteen and one-tenth down to thirteen and eight-tenths inches.

Perhaps the most careful observations in connection with the effect of rainfall upon pasturage have been made in Australia, the question being very important owing to the immense arid regions in that country. It has been set forth, and probably with a fair degree of authority, that annual rainfall is a most reliable index as to the pastoral capacity of a country, since grass benefits by rain at any season. Australian records show that land favored with less than ten inches of rain a year is quite valueless without irrigation. In such regions only one sheep per square mile can be carried for each inch of rainfall. For from nine to thirteen inches, however, the increase is about twenty sheep per square mile, and for from thirteen to twenty inches of rainfall the increased carrying capacity is about seventy sheep per square mile.

It has been estimated that the sandy land in the San Joaquin valley, California, would feed about one sheep to the acre in its natural state; but when irrigated, and growing alfalfa, it carries twenty.

The question of the amount of minimum rainfall, and of its distribution according to seasons and years, is one of prime importance for the development of the Western States and Territories; and careful and long-continued researches on the meteorological conditions, more particularly on the precipitation, will be of the greatest value to settlers. The chief signal-officer concludes his report with a recommendation to extend observations upon the rainfall in the Western States and Territories by a gratuitous distribution of gauges to reliable voluntary observers who reside in counties from which rainfall reports are not now obtainable.

PRIMARY EDUCATION IN GERMANY.

IT is commonly held that in Germany the public-school system, beginning with the university and ending with the primary school, has reached a higher degree of excellence than has been attained anywhere else. The term "Germany" as generally used in this connection is somewhat vague; for the schools are managed differently in different parts, and the various systems are not equally good. In an article in the *Journal of Pedagogy* by O. B. Super of Dickinson College, Carlisle, Penn., a view is given of the system where it has reached its highest excellence.

The first point requiring attention is, that in Germany every thing relating to schools of any kind is done according to a regular system; and this, of course, is a great advantage, to begin with. We sometimes talk of our public school system, but it would be difficult to say what that system is. Ever since there have been white men in America, means have usually been found to give most of the rising generation some kind of an education; and this is about all we can boast of now, for, under the existing order of things, a very large number of children get no education. The census of 1880 shows that we have among us 6,239,958 children who cannot write their names, and this fact alone is enough to prove that our so-called system comes very far short of doing what it ought to do.

The German Government is careful, first, that suitable buildings are erected for school purposes, and then looks to it that they are provided with proper furniture, books, apparatus, and teachers. Before a new school-building can be erected, the law requires attention to the following particulars: the location must be central; it must be removed from busy streets and noisy or ill smelling factories; the ground must be dry and with sufficient elevation to allow of proper drainage; there must be a dry and clean yard large enough for a play-ground; and the government provides swings, cross-bars, and other appliances for out-door gymnastics. School architecture in America usually depends very much on the character or intelligence of the man who has undertaken the "job." The government further provides the following apparatus for every school: in the primary grades, alphabetical charts, abacus, the metric ruler, two black-boards, a wall-map of the province in which the school is located, a relief-map of Germany, a wall-map of Palestine, and some charts of natural history. In the grammar and high school grades there is much more, including chemical and philosophical apparatus.

But the great point of superiority of their schools lies in the teachers. A good teacher will have a good school in spite of all drawbacks, and a poor teacher will have a poor school in spite of all advantages of building and apparatus. The reason why German teachers, as a rule, are superior to ours, is that the former have been specially trained for their work. With us it seems to be a generally accepted theory that almost any one can teach, provided he knows just a little more than the persons of whom he is to have charge. In Germany, teaching, even in the primary schools, is recognized as a profession, which unfortunately is not the case in this country. Here the average teacher might with propriety be called a sort of "pedagogic tramp;" for in country districts, at least, the same teacher rarely has the same school two successive terms, and the records of some counties in Pennsylvania show that every year more than one-third of the schools have teachers that are entirely without experience, and in many cases they have just "graduated" from the country schools themselves. It will doubtless be found that the same condition of affairs prevails in every State west of Pennsylvania. A very large majority of public-school teachers, if they are men, are only using this occupation as a convenience until they are able to find something more suited to their tastes. If they are women, the probabilities are that in a few years they will marry; and, if they have any thing to do with managing children after that, it will not likely be in the public school. In either case, teaching is looked upon as something one ought to get out of as soon as possible.

In Germany no one is permitted to teach, even in a primary school, unless he has satisfactorily completed the course of study prescribed by the "Teachers' Seminary." Even private schools are subject to the same rigid supervision as the public schools, and no one is allowed to set up a school until he has demonstrated his fitness to teach. With us, private and parochial schools are not seldom worse than the public schools; for, while the former usually have some kind of supervision, the latter have no authorized overseers at all.

In order to be admitted to a "Teachers' Seminary," the applicant must be between sixteen and twenty-four years of age; must have a certificate from his former teacher, testifying to his moral character, good habits, industry, and ability; and must be able to pass an examination in what are usually called "common-school" branches, together with history of Germany, elements of natural philosophy, religious doctrine, and Bible history and music. At the seminary he studies all these, and some higher branches in addition. After completing this course, he must serve two years as assistant to an experienced teacher. If he sustains this ordeal, he is then required to pass a final examination, when he is supposed to be fit to take charge of a low-grade school; but he has now been raised to the rank of a "school-master," is recognized and honored as a member of a noble profession, with a position for life, and a salary that is not large but always sufficient to enable him to maintain his position with respectability, and with the certainty that if he does his work well he will be promoted to the

higher grades of his profession. An examination is necessary before every promotion; so that he must not only teach well, but must keep up with what is going on in the branches which he is required to teach. He teaches about thirty hours a week for ten months of the year, receiving a salary ranging from twenty-five dollars to ninety dollars per month, and a house free of rent. Considering the price of living, this is better compensation than the average American teacher gets. The average salary of the 23,681 teachers in Pennsylvania is $34.35 per month, and the report from which these figures are taken does not give the lowest salary paid. In some instances it is probably not more than ten dollars a month. As showing the transitory nature of the teacher's occupation in this country, it may be stated, that, of the above twenty-three thousand teachers, over eight thousand had been in the work less than five years. To judge from a statement made some years ago by a prominent Ohio educator, the tenure in that State is still more unstable. Besides, the German village schoolmaster is socially the equal of any of his neighbors, and he and the pastor are the most important personages in the place.

After the German teacher has served ten continuous years, his salary is increased by a small yearly pension; and if he should, on account of age or for any other reason, be unable to continue his labors, his pension is so increased as to afford him a comfortable living. If he dies and leaves a widow, she is pensioned, as are also all children under the age of twelve years whom he may happen to have. The State thus recognizes the teacher in the public school as being of equal value with the soldier; for, if either is disabled in the service, he is pensioned; and if he dies, his family is provided for.

It must not be inferred, from what has been said above, that it is advocated to transfer, as a whole, the German public-school system to the United States. We must make our own system, not borrow one already made. The only object has been to show that in the way of public schools we have more to learn of some European countries than they of us. While it is freely admitted that we have many schools quite as good as any that can be found elsewhere, yet one need only keep his eyes open in order to become fully aware that we have many schools and school-teachers that could not exist under the system sketched above.

DO WARM SUMMERS FOLLOW WARM WINTERS?

ALMOST every newspaper of Boston has recently had something to say about what the weather is to be during the coming summer; and it seems to be an almost unanimous conclusion that the following summer is to be warm because the winter and spring have been warm, or because last summer was cool. This has led Mr. H. H. Clayton to examine the temperature observations made in Milton during the last forty years by Mr. Charles Breck. These observations have been made twice daily from the same thermometer, hanging in the same place since the beginning of the observations in January, 1849. During the forty years, nineteen winters have been warmer than the average, and eight of the following summers have been warmer than the average. There have been eleven cases in which both the winter and spring have been warmer than the average, and following these there have been five summers warmer than the average. There have been six decidedly warm winters, that is, winters whose mean temperature was three degrees or more above the average; and four of the following summers have been warmer than the average. It is seen, then, that only about half of the warm winters were followed by warm summers; or, in other words, cool summers have followed warm winters as often as the reverse. The number of times warm summers have followed cool summers is nine, while the number of times cool summers have followed cool summers is twelve.

In the above, what has been called a warm winter is one in which the mean temperature of the three winter months — December, January, and February — has been higher than the average of forty years; and what has been called a cool summer is one in which the mean temperature of the three months of June, July, and August has been lower than the average of forty years, etc. This, however, is evidently not the definition adopted by people generally in deciding whether a winter or summer is colder or warmer than usual, for a decided departure of the temperature of a single month in any direction may determine the impression people retain of the entire season. Thus it will surprise most people to learn that the mean temperature of last summer was slightly higher than the average of the last forty years. Both June and August were warmer than usual, and only July was very cool. It will probably be a still greater surprise to learn that the winter of 1887–88, which was generally thought to be a cold winter, was really slightly warmer than usual. December and February were both warmer than usual, and January alone was very cold. Thus people's opinion of a season seems to be largely moulded by the special character of what is usually the most extreme month of the season. If in winter January happens to be exceptionally warm or cold, the winter is decided to be of the same character; or if July happens to be decidedly warm or cool, the summer is thus characterized. It seemed, then, worth while to ascertain from Mr. Breck's record how many warm Julys followed decidedly warm Januarys. There were eight Januarys during the forty years whose average temperature was above 30°, and following these were five Julys warmer than the average of forty years; which indicates but a slight tendency for warm Julys to follow warm Januarys, since the law of chance would indicate that four warm Julys ought to follow eight warm Januarys. The number of times warm Julys have followed cool Julys is twelve; and the number of times cool Julys have followed cool Julys is eight.

Another method frequently used in predicting the weather of a coming season is based on the conclusion that during every year the average conditions remain about the same; and if the first part of the year is very warm, the latter part must be cool. This assumption, however, appears to be entirely unsupported. Mr. Breck's observations show that the mean temperature of one year may differ as much as five degrees from another. Eleven months of 1877 were observed to be warmer than usual, and nearly as great departures in the opposite direction were found in other years.

All of these facts indicate that no conclusion of any value greater than could be gained by mere guessing can be formed in regard to the character of a coming season, merely by knowing the character of a past season, until some law connecting these is worked out. This has been demonstrated over and over again in different parts of the world; but since, of course, people generally cannot keep posted in meteorological literature, there will probably continue to appear such forecasts of coming seasons, based on apparent scientific conclusions. Mr. Clayton feels sure there is a law of recurrence of meteorological phenomena besides the daily and annual periods, and also that it is not of the character usually supposed and discussed above.

NOTES AND NEWS.

IN an account of the Widdifield & Bowman Company's electric and automatic car-brake, in *Science* of May 31, p. 412, second column, 10 lines from the bottom, "in 11 seconds" should read "in 77 seconds." This company now have an office at Room 125, Temple Court, this city.

— Dr. Hellmann has published, in the *Centralblatt der Bauverwaltung*, a brief study of a cloud-burst, Aug. 2 and 3, 1888, in the Riesengebirge, in Silesia. The storm was on the west side of a storm area which was moving northward from Galicia. The rain fell from fifteen to eighteen hours, and in some parts of the Queiss valley its depth reached 200 millimetres, or 7.9 inches. Such a rainfall had not been known there before since 1804. A similar cloud-burst occurred in the region just south-east of this, in the Sudeten and Beskiden Mountains, in 1884, accompanied by a similar unusual progression of a storm area northward over Galicia and Polen.

— The governing committee of the Nineteenth Century Club of New York reports, that, notwithstanding the shadow cast over the club by the death of its founder and president, the last season has been a successful one. The meetings have been marked by a full and sometimes a crowded attendance, the membership is substantially unimpaired, and, so far as the committee can judge, the interest in the club's work remains unabated. The committee believes that nothing more is necessary than to continue on the same