midnight of each day to the succeeding midnight. The following table exhibits each prediction and the weather that followed:—

Prediction.		Weather.				Prediction.		Weather.			
(1)	(2)	7	3	10	rain	(1)	(2)	7	3	10	rain
rain	rain	cloudy	cloudy	clear	.05	fair	fair	clear	clear	clear	0
rain	rain	fog	clear	cloudy	.02	fair	threat.	fair	cloudy	cloudy	.01
rain	threat.	cloudy	fair	clear	0	fair	threat.	cloudy	clear	clear	0
fair	threat.	clear	fair	cloudy	0	rain	fair	clear	cloudy	cloudy	0
fair	threat.	clear	fair	fair	0	rain	rain	lt. rain	cloudy	cloudy	.96
fair	fair	clear	fair	fair	0	fair	fair	clear	cloudy	cloudy	0
fair	fair	cloudy	cloudy	cloudy	0	fair	fair	clear	fair	clear	0
rain	rain	lt. rain	cloudy	cloudy	.76	fair	fair	cloudy	cloudy	cloudy	0
fair	fair	fair	fair	clear	0	rain	threat.	clear	clear	cloudy	0
fair	fair	fair	cloudy	clear	0	fair	fair	fair	cloudy	cloudy	0
fair	fair	clear	cloudy	clear	0	th.	fair	cloudy	cloudy	fair	0
fair	fair	clear	clear	clear	0	rain	threat.	cloudy	clear	fair	0
						th.	fair	fair	cloudy	fair	0

It will be seen that the prediction was the same in fifteen cases, and eleven of these were fully verified. In order to obtain a fair comparative estimate for the remaining ten days, the predictions and the succeeding weather were referred to Prof. I. Russell, who decided that No. (1) agreed better with the weather twice, and No. (2) eight times. If these ten be regarded half verified, we shall obtain for No. (1) 48 per cent and No. (2) 60 per cent.

The predictions were also referred to Professor Upton, who suggested two schemes for verification, by one of which he computed No. (1) 67.2 per cent, and No. (2) 69.6 per cent; and by the other, No. (1) had 61.0 per cent, and No. (2) 65.0 per cent. As Professor Upton preferred the second scheme, I give it in detail. His plan was as follows:—

Arrange all possible weather-combinations in a table, and give to each prediction a certain weight according to its position in the table, as follows:—

Weather.			Predictions.		
			fair	threatening	ra
clear	clear	clear	3	0	0
clear	clear	fair	4	1	0
clear	fair	fair	4	1	0
fair	fair	fair	4	1	0
clear	clear	cloudy	3	2	0
clear	fair	cloudy	3	2	0
fair	fair	cloudy	3	2	0
clear	cloudy	cloudy	2	3	1
fair	cloudy	cloudy	2	3	1
cloudy	cloudy	cloudy	1	4	2
trace	of	rain	0	3	3
	rain		0	2	4

In this scheme it is possible that too much weight has been given 'fair,' and too little 'threat.' However, as the prediction 'threat.' seems of doubtful utility, it should have less weight.

This discussion has brought out one fact of great interest regarding methods of verification. Mr. Clayton verified the same predictions by the observations at Blue Hill, a station very near Boston. He makes the percentage 85. This great difference of 24 per cent seems very surprising, and can hardly be due to the difference in weather at the two places. It seems probable that this difference is due to the method of verification, and that a mere percentage obtained from an arbitrary verification cannot be relied on for comparing the relative merits of two predictions. It is to be hoped that a further discussion of this question may lead to clearer light and understanding of the methods of prediction and verification best suited to the needs of the public.

H. A. HAZEN.

Washington, D.C., Dec. 14.

The Chinese Wall.

THE note on the Chinese wall in a late issue of *Science* (x. No. 253), calling attention to Abbé Larrieu's assertion that the wall does not exist, recalled to mind Abbé Huc's account. Turning to it, I find that he was a believer in it, and with good reason. In Vol. II. of his 'Journey through Tartary, Thibet, and China,' p. 31, he gives the following account, which may interest some of your readers, and serve to correct an erroneous impression:—

"The part of the wall immediately to the north of Pekin . . . is really fine and imposing; but it must not be supposed that this barrier is equally large and solid throughout its whole extent. We have had occasion to cross it at more than fifteen different points, and have often travelled for days together without ever losing sight of it; and instead of the double battlemented stone wall which is seen at Pekin, it is sometimes a very humble-looking wall of clay; and we have even seen it reduced to its simplest expression, and composed only of stones piled up together."

Thus, though the wall may not and does not have the magnitude and solidity often attributed to it, yet in one form or another it certainly seems to exist, and is not, as we are told Abbé Larrieu says, 'a huge Chinese lie.'

JOSEPH F. JAMES.

Miami Univ., Oxford, O., Dec. 20.

Tornado Force.

I SEND you some facts in relation to tornado force and its peculiarities of action, which may not be uninteresting to your readers, on either side of the question, involving the nature of the force or forces.

The tracks examined by me did not present continuous lines of destruction, but areas of destruction separated by intervals entirely or almost entirely exempt from destructive forces, from which it is inferred, that while the storm, in its common and ordinary features, pursued its way steadily onward by bodily transferrence, the tornadic action was developed interruptedly, and progressed by successive transplantings.

The first area examined, tornado of April 23, 1883, was composed of two distinct parts. The first was a long rectangular space of about half a mile in length, from west-south-west to east-north-east, and a hundred and fifty to two hundred yards in width. Within this space the trees were prostrated from south-east, south, south-west, and west, and intermediate points; and, wherever two or more were found lying across each other, the one thrown from the direction nearest to east, or farthest round from west, was always at the bottom. Thus, those thrown from south always lay on top of those from south-west, those from south-west on top of those from south and south-east, and those from west were always on top of all other directions. This order was without an exception. The rectangular area terminated at the east end in an irregularly circular area of about eight hundred yards diameter, either east and west or north and south. Bisecting this area both ways, and dividing it into four quadrants, the south-west and south-east were found to correspond in all respects with the rectangular area, except that in the south-east there was a greater proportion of trees thrown down from east-south-east and south-east than in the other sections; and in the south-west quadrant, near the centre, a tree thrown from south-west was overlain by one from south, the single exception to the order noted above. In the north-east quadrant the destruction was less than in either of the others, and trees were thrown down from east, north-east, north, north-west, and west. In the north-west quadrant the trees were thrown from north, north-west, and west, chiefly from north-west, west-north-west, and west; and in the instances where they crossed each other, the order in relation to the west was similar precisely to that of the other parts, progressing from east round by north to west, as, on the other side, the progression was from east round by south to west; so that in these, the north-east and north-west quadrants, trees thrown from north-east lay under those from north, those from north under those from

north-west, while, as in the south quadrants and in the rectangular space, those from west were on top of all. The central line, west to east, through the circular area, corresponded very closely with the prolongation of a line running through the north border of the rectangular area. In the south-west quadrant a slim pine seventy to seventy-five feet high was left standing, surrounded by seven stumps or shafts varying in height from ten or fifteen to forty or more feet, and in distance from the standing tree, from five to twenty-five feet. Near the centre of the circular area two trees stood side by side, east and west of each other, and so near that their trunks at the bases could not have been more than a few inches apart, if they did not actually touch. The tree on the east side was thrown from west to east, and the other in the opposite direction, from east to west. Two pines fifty to sixty feet high and thirty to forty feet apart, one in the south-east, the other in the north-east quadrant, and about equidistant from the east and west central line dividing these quadrants, were thrown towards the central line, the one from north to south, the other from south to north (tornado of Dec. 22, 1884). They apparently fell simultaneously, and met in the fall; for their broken trunks and branches were mingled together in a confused heap, the branches of one tree undistinguishable from those of the other. The cabin of Isaac Johnson, a negro laborer, situated in the track, near the western end of the rectangular area, was partially unroofed and otherwise damaged. He stated that his table-ware — plates, spoons, knives and forks — went flying out of the door like so many birds; and after the storm he found his fanner securely poised on a stump, bottom upwards, about seventy yards from his cabin; and on the fanner lay his nutmeg-grater, as though placed there by hand (the fanner is a shallow, tray-like vessel made of straw). The trunks of some trees, pine and hickory, seemed to have been rent asunder, as by a splitting force acting within the trunks, and in these cases the upper segment was scarcely ever entirely separated from the stump; and from both stump and upper fragment, long, thin, lath-like splinters projected, some of them eight to ten feet in length, an inch or two in width, and a half to three-quarters of an inch in thickness. About half a mile to the east of the eastern terminus of this tornadic area, the second area of destruction began, and presented a rectangular area like the first, several hundred yards in length; but here the conformity with the first ended, the forces appearing to have become scattered. The circular area was undeveloped, the north-east and south-east quadrants being entirely wanting, and the north-west quadrant defective, in so far as the forces acting from north and north-west were concerned. The south-west quadrant presented patches of destruction here and there, with features similar to those of the like quadrant of the first area; and here, too, was a single exception to the order in which the forces everywhere else acted, namely, a tree thrown from south overlying one from south-west. The trees prostrated in the north-west quadrant were thrown from the same directions as those in the south-west, as though the forces acting in this section had burst through the barriers of the central line, or, finding them defective, had swept on through the north-west quadrant, thus giving a zigzag shape to this area.

Appearances seem to indicate that the work of destruction began and progressed throughout all parts of each area almost if not quite simultaneously.

During the tornado of Dec. 22, 1884, in Clarendon County, a lady, perceiving the approach of the storm, was in the act of closing a glazed door, which extended down to the floor and opened on a piazza; but before she could fasten it, the house was enveloped by the tempest, the door flew open, and she was drawn out and dashed violently against the balustrade running around the piazza, and received injuries and bruises which confined her to bed for several weeks. In the same room there was a heavy pine press, the door of which was locked. This door was burst open, torn from its hinges, and, in the language of the narrator, "shivered into kindling splinters." There was no other damage done to the house, at least none mentioned. I have examined the tracks of three tornadoes, — April 23, 1883; Feb. 19, 1884; and Dec. 22, 1884, — and they corresponded so exactly in their various parts, that the conviction is irresistible that the features described, especially those indicating the directions and order in which the forces acted, will be invariably found in the track of every tornado.

Notwithstanding the intense atmospheric disturbance, which, judging from ordinary thunder-storms, is of just such a character as to produce vast supplies of electricity, the usual electrical manifestations, lightning and thunder, are tame, and out of all proportion to the intensity of the atmospheric disturbance in the tornado as compared with an ordinary thunder-storm. In the tornado there are never, I think, any discharges from the clouds to the earth; objects are never struck by lightning; the thunder, when it occurs, is always high up among the clouds, and rolls away across the sky in long reverberating peals; showing that the static electricity is confined to the upper clouds, and the supply by no means superabundant. What, then, becomes of the electricity of the lower clouds? Does it remain dormant, or does it in some way aid in the destruction?

W. W. ANDERSON, M.D.

Stateburg, S.C.

The Study of Languages.

IN the number of *Science* issued July 8 of this year, p. 19, is the following passage: "The advantages of the ability to read an ordinary classical author without the aid of a dictionary are so obvious as to need no comment."

I was called from home immediately after reading the above, hence my delay in seeking from the writer an extended explanation of the means by which the student can read an ordinary Latin author without a dictionary.

Is there really any practical method by which he can accomplish this, except by employing his dictionary so faithfully that he has no further use for it?

I do not believe an accurate knowledge of a language can be acquired by reading at sight one page or any number of pages, unless the student comprehends the exact signification of each word as he passes it. It is true, such an exercise increases his facility in understanding the words and sentences he has already studied.

Reading aloud over and over again what one has already read, together with committing to memory poems and passages from prose authors, is, I believe, the best if not the only practical method of acquiring an ability of reading Latin or any language at sight.

H. L. E.

Chicago, Dec. 20.

Queries.

20. STAR OF BETHLEHEM. — I see paragraphs going the rounds of the papers about the 'Star of Bethlehem,' that is claimed to be a binary system, and to give its maximum light once in three hundred years. Some claim it was the star in the east, seen by the wise men. Please tell us in *Science* if there is any thing in these rumors, and, if so, where in the heavens the star can be seen.

JOHN D. PARKER.

Fort Riley, Kan., Dec. 24.

21. GLOBULAR LIGHTNING. — The following report from the Hydrographic Office relates to one of the rarest and most inexplicable forms of lightning. Can any of the readers of *Science* give any information on the subject? A globe of fire floats leisurely along in the air in an erratic sort of a course, sometimes exploding with great force, at other times disappearing without exploding. On land it has been observed to go into the ground and then reappear at a short distance, and where it entered the soil it left a rugged hole some twenty feet in diameter. Although there is no doubt as to the facts regarding the phenomenon, no satisfactory explanation of the cause has ever been given. It is, of course, entirely different in character from St. Elmo's fires, so often seen on board vessels during thunder-storms: these remain stationary at the yard-arms and mast-heads, and are analogous to the 'brush discharge' of an electric machine. Captain Moore, British steamship 'Siberian,' reports, "Nov. 12, midnight, Cape Race bearing west by north, distant ten miles, wind strong south by east, a large ball of fire appeared to rise out of the sea to a height of about fifty feet, and come right against the wind close up to the ship. It then altered its course, and ran along with the ship to a distance of about one and one-half miles. In about two minutes it again altered its course, and went away to the south-east against the wind. It lasted, in all, not over five minutes. Have noticed the same phenomenon before off Cape Race, and it seemed to indicate that an easterly or south-easterly gale was coming on."