

The *Cirro-stratus*, but more especially the *Cirro-cumulus*, are remarkable by reason of a characteristic of the highest importance, from the point of view of the distribution of congealed aqueous vapour, and one which has escaped the sagacity of Howard and his successors. It consists in the most fantastical combinations, reproducing all the formations, hydrological, and physical, of our Continent and seas. Here a deep bay with promontories, capes, peninsulas, isthmuses, &c.; there, a river, brooks, lakes, &c. ! further on, vast continents and open seas. The entire mass and the outlines of each of these accidents are besprinkled with *Cirro-cumulus*, sometimes edged with *Cirro-stratus*, of which the volumes of little balls are seen diminishing and vanishing from centre to circumference, while at the side, in the empty spaces, we perceive the purest azure of the heavens. Should it be a lake, the water will be represented by the blue sky, and *terra firma* by the *Cirro-cumulus* which surrounds it. By carefully studying all these transformations we remark in them the greatest analogy with the phenomena of the precipitation and congelation of dew upon solid bodies. There is, therefore, at this altitude, in the same stratum, and one after the other, so to say, some portions of the atmosphere enjoying different degrees of density and of temperature, in order that the congelation of aqueous vapour may take place in so variable a manner.

The influence of *Cirro-cumulus* upon the lowering of the temperature at the surface of the earth is so considerable that the human body feels it at once. A curdled sky at the new moon of a calm night in the tropics is a sky relatively glacial for these latitudes.

This effect may be due to their greater proximity and to the considerable quantity of balls of snow which constitute this type of cloud. The *Cirrus* being found much elevated and the *Cirro-stratus* much less abundant, although both are formed of glacial aiglets, have not the same influence upon the terrestrial temperature. Howard says :

"The *Cirro-cumulus* is formed from a *Cirrus*, or from a number of small separate *Cirrus*, by the fibres collapsing, as it were, and passing into small, roundish masses, in which the texture of the *Cirrus* is no longer discernible; although they still retain somewhat of their relative arrangement. This change takes place throughout the whole mass at once, or progressively from one extremity to the other. In either case the same effect is produced on a number of adjacent *Cirrus* at the same time and in the same order. It appears in some instances to be accelerated by the approach of other clouds.

"This modification forms a very beautiful sky, sometimes exhibiting numerous distinct beds of these small connected clouds, floating at different altitudes.

"The *Cirro-cumulus* is frequently seen in summer, and is attendant on warm and dry weather. It is also occasionally and more sparingly seen in the intervals of showers and in winter. It may either evaporate or pass to the *Cirrus* or *Cirro-stratus*."

Under the generic name of *Pallium*, I have classed two forms of clouds, which present the appearance of a mantle or veil of considerable extent, of very compact texture, well defined at the edges, of an excessively slow march, and embracing, moreover, the visible vault of the sky. According as the *Pallium* is formed of *Cirrus* or of *Cumulus* it is distinguished into *Pallio-cirrus* and *Pallio-cumulus*. The appearance of these clouds signalises bad weather, and their disappearance good weather.

The stratum of *Pallio-cirrus* is first formed, and some hours or some days afterwards that of *Pallio-cumulus* is formed under it. These two strata remain in view at a certain distance from each other, and by their reciprocal action and reaction produce storms and the heavier rains, accompanied with considerable electric discharges. They are electrified, but with contrary signs; the superior stratum of *Cirrus* is negative, and the inferior one of *Cumulus* is positive, the same as the rain which it disengages; while the electricity of the air, at the surface of the earth, is negative. But when these two strata attract each other a discharge is produced; and the inferior stratum continues to pour out the surplus water it contained without giving any sign of electricity, no more than the air in contact with the earth. This state continues until the inferior stratum opens up, the superior afterward, they then disappear, the one after the other. Fine weather then returns. The *Pallium* chiefly predominate during the rainy season, in inter-tropical regions, and in the higher latitudes during winter, at the time of falls of snow. A part of the

Pallio-cumulus, which has not been reduced, or which has not been scattered to other regions, gathers at the horizon and is transferred into the *Cumulus*. As to the *Pallio-cirrus*, they disappear entirely if fine weather is maintained.

THE ANCIENT LAKES OF WESTERN AMERICA, THEIR DEPOSITS AND DRAINAGE *

THE wonderful collections of fossil plants and animals, brought by Dr. Hayden from the country bordering the Upper Missouri, are from deposits made in extensive fresh-water lakes which at one time occupied much of the region lying immediately east of the Rocky Mountains. The water of these lakes was first salt or brackish, as the remains of oysters and similar estuary forms show. By continental elevation the whole country west of the Mississippi was raised out of the cretaceous sea, and these estuaries became lakes inclosed by raised dry land. The knowledge of this country from the Mississippi to the Pacific Ocean has been accumulated by various explorers besides the writer, as Dr. Hayden, Mr. George Gibbs, Professors W. P. Blake and Thomas Antisell, and Prof. J. D. Whitney and the State Geological Survey of California, and Baron Richtofen, the lamented Rémond, Drs. Shiel, Wislizenus, and others. Besides Mr. Clarence King has explored a large tract of this country, but his very important contributions have not, as yet, been made public. The general character of the topography of the region west of the Mississippi has been given by these great lines of elevation traversing the country from north to south. There are the Rocky Mountains, the Sierra Nevada, and the Coast Ranges. The last is the most modern, and is composed, for the most part, of Miocene Tertiary rocks. Parallel with this lies a narrow trough, in California traversed by the Sacramento and San Joaquin Rivers, encroached on by the mountains at places, but still in Oregon and Washington, traversed by the Willamette and Cowlitz Rivers. These two sections are drained through the Golden Gate and Columbia. The mountain barriers formerly caused the valleys to consist of great inland lakes, which are now only represented by the chain of small pieces of water still to be seen in that region of country. East of the Sierra Nevada and between it and the Rocky Mountains is another still larger basin. For a thousand miles it has no openings to the westward, which are less than five thousand feet above the sea, but at three points there are gateways, which may be passed, but little above the sea level. These are the *canons* of the Sacramento (Pit River), the Klamath, and the Columbia. These have been cut through by the drainage of the interior of the continent. The former beds of the lakes have thus been left dry and waste—the only real desert on the North American continent. The Sierra Nevada is older than the Coast Ranges, and projected above the ocean, though not to its present altitude, previous to the Tertiary and even Cretaceous ages. This we learn from the fact that strata belonging to these formations cover its base. The mass of the Sierra Nevada is granitic rocks and metamorphic slates, proved by the California Survey to be triassic and jurassic. These slates are traversed by the gold-bearing quartz. East of the Sierra Nevada is a high and broad plateau five hundred miles wide, and from four to eight hundred feet in altitude, and reaches south into Mexico. This mountain belt was once the margin of the Pacific Ocean. Its crest is crowned by volcanic cones like gigantic towers of a fortification. The central portion of this plateau was called by Fremont "the great basin," as it forms a hydrographic basin drained by the Columbia and Colorado. The former makes its way to the ocean through a gorge in the Cascade Mountains, whilst the latter escapes to the south through a series of *canons*, of which the most important is nearly a thousand miles in length, and from three to six thousand feet deep. In vol. vi. of the Pacific Railroad Reports the country of the Columbia is described and the reasons for concluding that it had cut its way through the Cascade Mountains, and similar facts were observed in the district drained by the Klamath and Pit Rivers. Certain peculiarities are to be seen in the country between the Sierra Nevada and Rocky Mountains. In the northern and middle portions of the great table lands the surface is somewhat thickly set by short and isolated mountain ranges, sometimes called "the lost mountains." These rise like islands above the level of the plain, and are generally com-

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