XXI. *Description of some remarkable Atmospheric Reflections
and Refractions, observed in the Greenland Sea. By*
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DURING the summer of the present year (1820), while navigating with the ship *Baffin*, the icy sea in the immediate neighbourhood of West Greenland (the east side), several extremely curious appearances of distant objects, produced by the reflective and refractive properties of the atmosphere, were observed.

The first of these, consisting chiefly of images of ships in the air, occurred on the 28th of June, in latitude $73^{\circ} 30'$, and longitude $11^{\circ} 50' W$. For two or three days previous, the weather had been intensely foggy, with the wind from the S. E., E. and N. E., blowing fresh. The day alluded to was beautifully clear; not a cloud, excepting the most delicate cirri, having appeared in the sky for twenty-four hours. The thermometer varied between 37° and 42° , and even at this moderate temperature, the sun was so powerful, that its intense light produced a very painful sensation in the eyes, while its heat softened the tar in the rigging of the ship, and melted the snow
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on the surrounding ice with such rapidity, that pools of fresh water were formed on almost every piece, and thousands of rills carried the excess into the sea. There was scarcely a breath of wind. The sea was as smooth as a mirror. The ice around was crowded together, and exhibited every variety, from the smallest lumps to the most magnificent sheets. Bears traversed the fields and floes in unusual numbers, and many whales sported in the recesses and openings among the drift ice. About six in the evening, a light breeze at NW. having sprung up, a thin stratus, or "fog-bank," at first considerably illuminated by the sun, appeared in the same quarter, and gradually arose to the altitude of about a quarter of a degree. On this, most of the ships, navigating at the distance of ten or fifteen miles, amounting to eighteen or nineteen sail, began to change their form and magnitude; and when examined by a telescope from the mast-head of the *Baffin*, exhibited some extraordinary appearances, differing in effect at almost every point of the compass. One ship bearing NW. by W. (Plate XVIII. Fig. *a*. sketch 1.) had a perfect image, as dark and distinct as the original, united to its mast-head in a reverse position; two others (Figs. *b* and *c*), at NW., presented two distinct inverted images in the air, one of them a perfect figure of the original, the other wanting the hull. Two or three more, bearing about north, of which one only is represented in the sketch (Fig. *d*), were strangely distorted, their masts appearing of at least twice their proper height, the top-gallant-masts forming one-half of the total elevation; and, at the same time, some vessels bearing NNE. and E., exhibited an appearance totally different from all the preceding. These, five in number, of which two only (Figs. *e* and *f*) are given in the drawing, were at the distance of twelve or fifteen miles, and consequently considerably beyond the natural horizon; but
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Telescopic Appearance of SHIPS, as observed in the Greenland Sea, during a very peculiar state of the Atmosphere. June 28th 1820. Latitude 73° 30' Longitude 11° 50' W.

N^o II.

Telescopic Appearance of the East Coast of GREENLAND, at the Distance of 35 Miles, when under the influence of an extraordinary Refraction. July 18th 1820. Lat. 71° 20' Long. 17° 30' W.

owing to the influence of some peculiar vapour in the air; they now seemed to advance so near, that they became distinctly visible, and the ice, for some minutes, appeared beyond them. Their masts seemed to be scarcely one-half of their proper altitude, in consequence of which, one would have supposed that they were greatly heeled to one side, or in the position called "Careening." Along with all the images of the ships, a reflection of the ice, in some places in two strata, also appeared in the air. The upper stratum of ice, in which the images of the ships terminated, was fifteen minutes of altitude from the apparent horizon. These reflections suggested the idea of cliffs, composed of vertical columns of alabaster. The stratus, which occupied the space intermediate between the reflection of the ice and the horizon, was, in some positions of the sun, highly illuminated, and shone like a sheet of distant water in a calm; but in other cases, as at the time when the annexed sketch was taken, it was a little darker in colour than the higher region of the atmosphere. To this fog, or stratus, then, it is probable all the reflections were owing; the double images being produced by two or more strata of fog; while a highly tremulous transparent vapour, resembling the steam of water before condensation, which could occasionally be discerned floating across the ice with the breeze from the NW. and N., occasioned, it is likely, the singular distortions observed in the form of every distant object seen through it. Hence, not only ships, but also the ice, was sometimes deformed by the refractive property of this vapour. The verge of the ice, in one place, became a considerable precipice; in another it appeared like distant land clad with snow; and a large hummock on the horizon was reared into the air (Fig. *a*) in the form of an obelisk. The appearances now described occurred between 6 and 12 p. m. The reflected images of the
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ice continued visible above two hours ; of some of the ships about half an hour ; and of others, presenting double reflections, about five minutes. The whole of the phenomena represented in the sketch were seen about the same time ; but they occupied a much larger extent than could conveniently be given in a drawing. There were some vessels in the SE. quarter, which were not in the least changed from their natural form or dimensions.

The atmosphere was again, in a similar state to that just mentioned, on the 15th, 16th, and 17th of July. Our latitude was then $71^{\circ} 30'$, longitude 17° W. Ice-fields and floes, with many smaller pieces, were in abundance around us. The wind was extremely light, the sky cloudless, and the temperature in the shade between 40° and 48° ; the sun, at the same time, was bright, and its rays powerful. On each of these three days, curious reflections from fog-banks, or refractions from tremulous vapour, were observed. The ice in the horizon was reflected in one, two, or three parallel strata, at the altitude, as seen from the deck of the Baffin, of ten to thirty minutes above the verge of the sea ; and where water occurred on the horizon, a blackish-grey undulating streak appeared in the atmosphere above it, exactly resembling the slight waves produced by a gentle breeze of wind, of which it was doubtless a reflection. In some places the reflected ice was in narrow faint streaks ; in others in bold bright patches, resembling cliffs of white marble, of the basaltic structure. Sometimes the phenomenon extended continuously through half the circumference of the horizon, at others it appeared in detached spots, in various quarters. From the deck of the ship, with a telescope, the inverted images of distant vessels were often seen in the air, while the ships themselves were far beyond the reach of vision. Some ships at the distance of six or eight miles, like those seen

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on the 28th of June, were elevated to twice their proper height, and others compressed almost to a line. Hummocks of ice here and there were surprisingly enlarged; and every prominent object, in a proper position, was either magnified or distorted. These appearances, though often visible to the naked eye, were not generally very striking; but when examined through a telescope, they presented an ever-varying scene of the most interesting imagery. Most of the phenomena now mentioned were seen on the 16th of July, at five o'clock in the afternoon. A stratus was then observed in the east, extending, north-about, as far as the north-west. In the latter quarter, including the azimuth of the sun, the sky was whitish and resplendent, so that the fog was concealed in the general glare.

Another instance of curious refraction will only be mentioned. This occurred on the 18th of July, under similar circumstances of weather, &c. as those already described. The sky was clear. The tremulous vapour was particularly sensible and profuse, though perfectly transparent. The temperature of the air at 9 A. M., the time when the phenomenon was first noticed, was 42° ; but in the evening preceding it must have been greatly lower, as the sea was in many places covered with a considerable pellicle of new ice. Such a circumstance, in the very warmest part of the year, must be considered as very extraordinary, especially when it is known, that ten degrees farther to the north, no freezing of the sea, at this season, that I am aware of, has ever been observed. The latitude of the ship was at this time $71^{\circ} 20' N.$, the longitude $17^{\circ} 30' W.$ Having approached, on this occasion, so near the unexplored shore of Greenland, that the land appeared distinct and bold, I was wishful to obtain a drawing of it; but on making the at-

tempt, I found I could not succeed with any degree of accuracy, since the outline changed as fast as I proceeded. The odd form of many of the hills, induced me to examine the land with a telescope from the mast-head, on which, finding it much disfigured by refraction, I contented myself with sketching a few of the most remarkable objects. These, accurately designed, yet disposed without regard to their proper order, or the moment of time when seen, are represented in the sketch, No. II. They afford a tolerable idea of the nature of the scenery then within view. The land, at this time in sight, extended from W. to NNW. (*per compass*); the nearest part at WNW, being about 35 miles distant. It seemed to be a barren and lofty country, abounding in mountainous ridges and peaks. There was much less snow on it than we usually find on Spitzbergen at this season : but in other respects it very much resembles that inhospitable country.

The general telescopic appearance of the coast was that of an extensive ancient city, abounding with the ruins of castles, obelisks, churches, and monuments, with other large and conspicuous buildings. Some of the hills seemed to be surmounted by turrets, battlements, spires, and pinnacles ; while others, subjected to one or two reflections, exhibited large masses of rock, apparently suspended in the air, at a considerable elevation above the actual termination of the mountains to which they referred. The whole exhibition was a grand and interesting phantasmagoria. Scarcely was any particular portion sketched before it changed its appearance, and assumed the form of an object totally different. It was perhaps alternately a castle, a cathedral, or an obelisk ; then expanding horizontally, and coalescing with the adjoining hills, united the intermediate valleys, though some miles in width, by a bridge of a
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single arch, of the most magnificent appearance and extent. Notwithstanding these repeated changes, the various figures represented in the drawing had all the distinctness of reality; and not only the different strata, but also the veins of the rocks, with the wreaths of snow occupying ravines and fissures, formed sharp and distinct lines, and exhibited every appearance of the most perfect solidity.