

ART. XVI.—ON SOME EXTRAORDINARY FORMS OF MIRAGE, BY  
WILLIAM KELLY, M. D.

READ 19TH MARCH, 1836.

When my attention was directed, some years since, to the different forms of objects, seen through mirage in the St. Lawrence, one of these, which I particularly remarked, was the flower-pot shape assumed by small islands, when affected by the mirage, which depends on the contact of warm moist air with a surface of water colder than its dew point. Whatever the real shape of the island, or rock might be, its top seemed raised and flattened; generally extending in a straight horizontal line so far on each side, as at least to equal the base in extent; often beyond it: whilst, midway between the base and distorted top, the figure was contracted, having the appearance of a neck, (Fig. 1). When two islands lay close together, these flattened tops sometimes met, giving the appearance of an arch from one to the other, (Fig. 2). In all other cases of mirage, depending on the same cause, the tops of objects seemed straight and horizontal in the same way, but the sides were like a wall. They frequently presented an appearance as if they were horizontally stratified.

In the paper on mirages published by the society in 1832, I hazarded a conjecture that these forms of arches, and flower-pots, might be owing to the beach of the islands being heated by the sun, and hence acting on the air, in contact with it, in a different manner from the surrounding cold sea. I have since found that the state of the air on the beach could have no share in producing the phenomenon; as we observed it when the islands were so distant, that the beach was below the horizon, and the refraction consequently was wholly owing to the state of the air over the water nearer to us. The cause of rocks and islands assuming this form was afterwards made manifest to me, as I had an opportunity of seeing the mode in which it occurred at Mingan, in July 1832.

On the morning of the 16th July, at 9-30, the wind was light and variable, the sky clouded but bright, the temperature of the

Fig 2

Fig 3

Fig 4

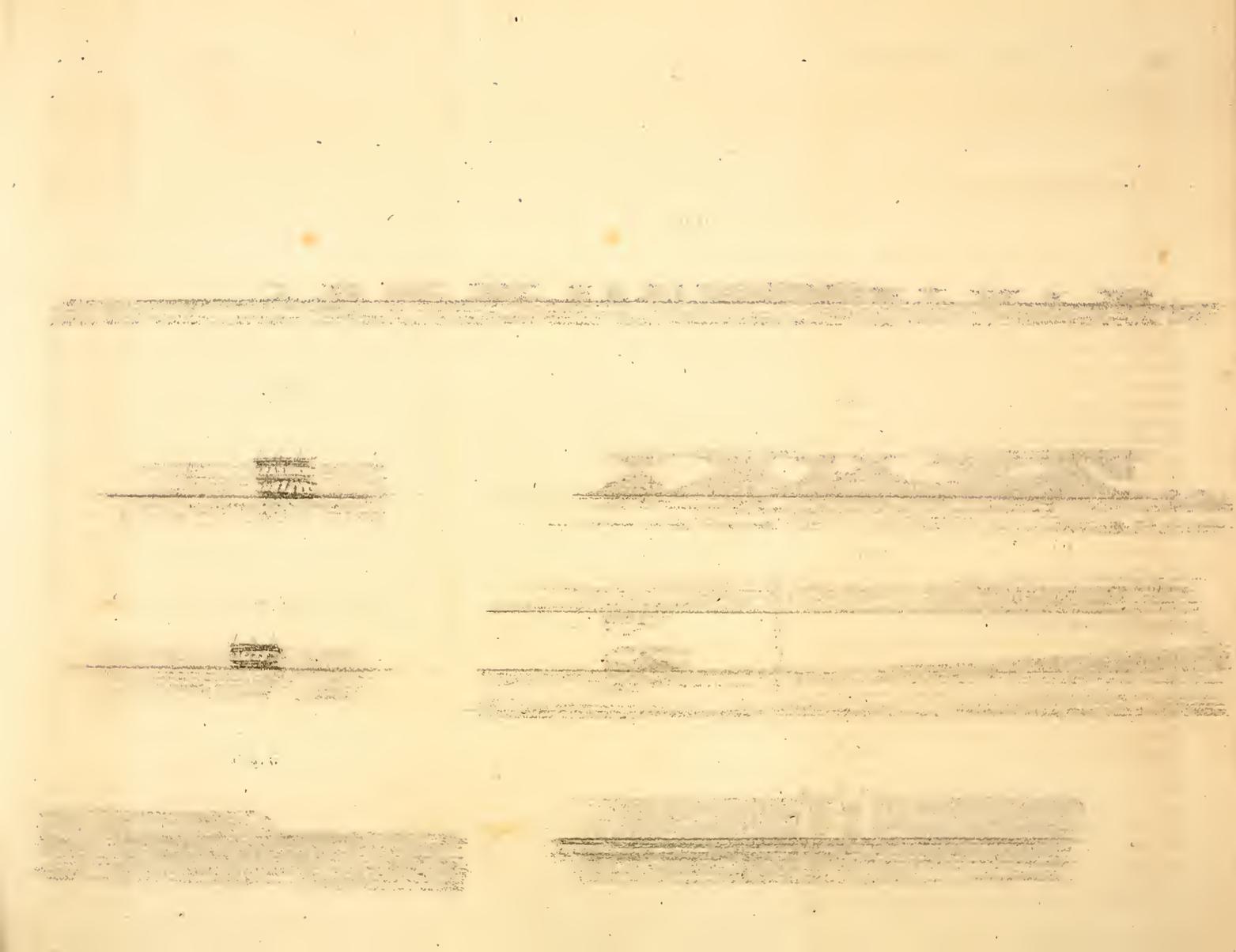
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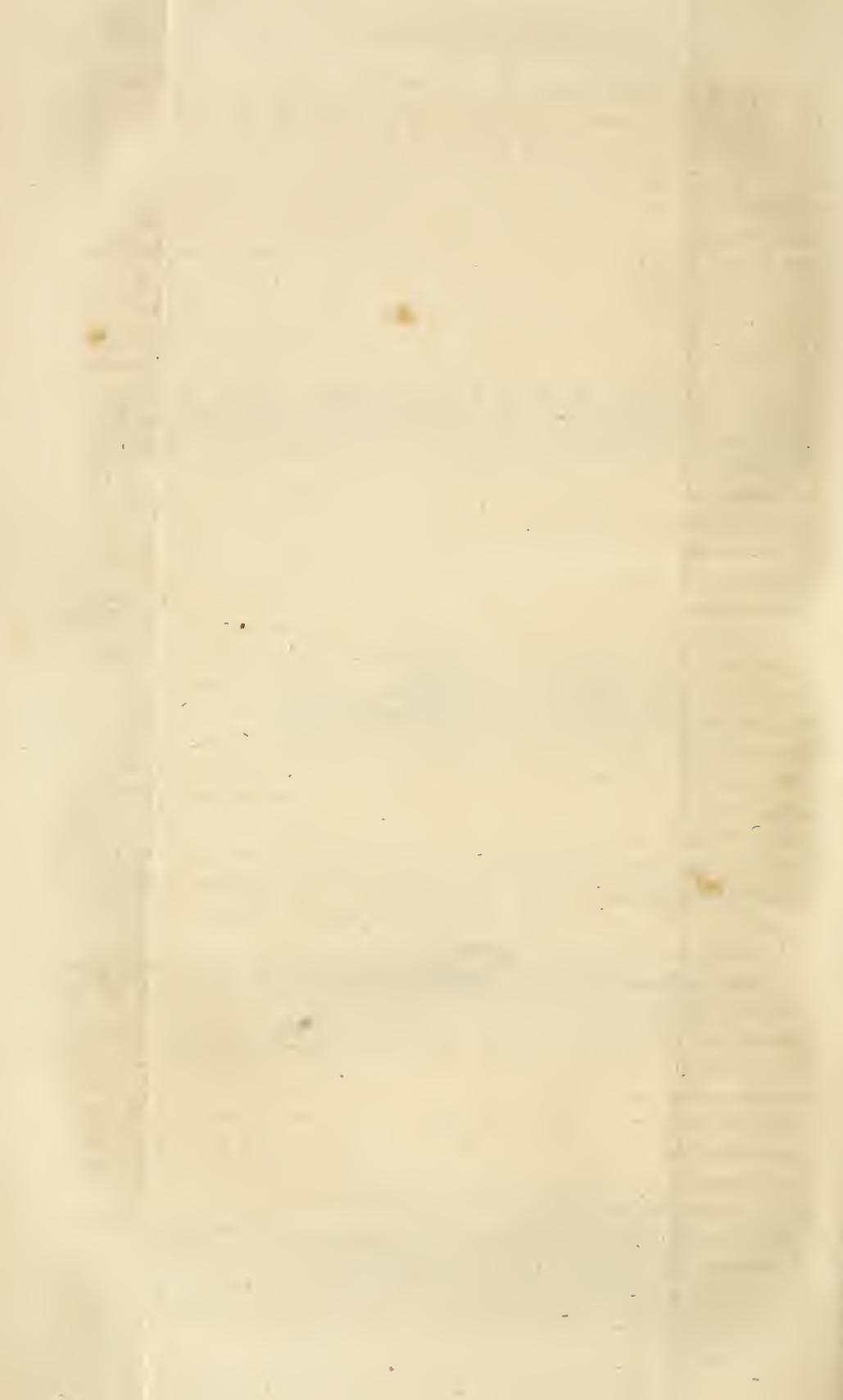
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air  $59^{\circ}$  the due point  $51^{\circ}$  the surface water  $44^{\circ}$ . One of the Perroquet islands, distant about 8 miles, seemed raised above the horizon, with a flattened top, and walled sides. At 10 A. M. the apparent height of the island above the water was diminished: the walled appearance of its sides, and flattened top were no longer perceptible; but on looking with a telescope it was found that the horizon itself was raised, causing the diminution in the relative height of the land. At 11-30 there was a light breeze from s. w: the sky clear, and the sun bright, the Perroquet then presented a well marked double image, the upper one being inverted. A fishing schooner, at anchor to the westward of the island, presented also a double image, the upper one inverted in the same way, but the whole less distinct than the images of the island. (Fig. 3). A line answering to the horizon, was also seen on a level with the upper flat part of the inverted image of the island, and extending from it to a sandy point on the main. The true horizon was quite distinct, and well marked beneath. The sandy beach between us and the point seemed raised like a wall. The two images of the island did not remain long distinct: the upper one gradually sunk, and when both met, the island had the flower-pot shape. There was a faint return of two distinct images, about a quarter of an hour after, but it lasted only a few minutes. On the 17th we had again an inverted image of the Perroquet, but not so distinct and well defined as the day before. It soon presented to the naked eye nothing more than the flat top and walled sides usually seen in this form of mirage. But on examining it carefully with a telescope, in some parts of the flattened top, the picture of a beach was seen above the trees; thus shewing that this form also depended on a second inverted image lying above, and confounded with, the upright one.

Since that time I have frequently observed the flower-pot shape of islands during the mirage; and by the help of a telescope, have found certain indications of the inverted image; the upper line generally extending as a false horizon, on the inferior edge of which, the play of the waters could be occasionally noticed. The upper portion of the flower-pot figure resembles the lower exactly in shape, as far as it extends; and the image of the stones of the beach, which is sometimes seen in it, leaves no doubt of its being an inverted picture.

All the various forms assumed by objects, under the influence of this mirage, seem to be the result of two or more images, alternately erect and inverted, either distinct or mingled together in a greater or lesser degree. When the objects are near,

the images are usually confused ; they are so occasionally in distant objects, but can, in most instances, be distinguished by the help of a telescope ; and sometimes they are beautifully distinct to the naked eye. The beginning of summer is the time when the contrast between the temperatures of the air and water is greatest. During the first four years of the survey, when we passed this time in the narrow parts of the river, we had no opportunity of observing more than a double image ; but in June 1832, we went at once to the gulf ; and in passing Point des Monts, where the breadth of the river is very considerable, we saw the three images distinctly marked, such as they have been described by Vince and Scoresby. The appearance they presented, and the attendant circumstances of both air and water, have been narrated by Captain Bayfield in a paper published in the Nautical Magazine for Feby. 1835. We have frequently since seen treble images in the destuary and gulf, but never so beautiful as on that occasion.

A telescope, if at hand, should always be employed in observing mirages of any kind, as it enables us to detect particulars, that would escape the naked eye. On one occasion, when to the naked eye, the hull of a ship seemed raised to an enormous height, and the sails very small, the telescope shewed three distinct images. Of the two lower the second was inverted, and its rigging and sails intimately mingled with those of the first upright one. The third image was erect, with its hull resting on the inverted hull of the second. (Fig. 4.) The space between the hulls of the first and second image being occupied by a confused mingling of masts, sails and rigging, gave to the whole the appearance of one immensely raised hull, as already stated.

By the help of the telescope we were afterwards enabled to detect five distinct images, though the whole gave to the naked eye the impression of only one almost shapeless mass, like that which I have just mentioned.

We were off Metis on the afternoon of the 14th of September 1835. There was a light easterly wind and cloudy sky : the temperature of the air  $48^{\circ}$ . the dew point  $40^{\circ}.5$  ; the surface water  $39^{\circ}.5$ . The barometer 29.90 falling. Some light rain fell two or three times during the afternoon, and we had very heavy continuous rain after night-fall. Several vessels were in sight between 3 and 4 P. M. and all presenting a variety of appearances from refraction. The most remarkable was that in which a vessel with all sail set, at one moment looked like an immense black chest, no sails or masts being visible. On observing her for a time the black body seemed to separate

horizontally into two parts ; and two sets of mingled sails occupied the intervening spaces, with one set of very small sails above. The figures afterwards became more distinct, and three images were clearly discerned. Another vessel changed also from the form of a great square flat-topped chest, to five distinct images, the upper with the sails erect, and the two lower double images with their sails rather confusedly intermingled. (Fig. 5.) A raised horizon was parallel to the upper figure of the hull. In a third case, the chest-like figure divided into two portions, of which one appeared much nearer than the other, the sea seeming to be interposed. This appearance occurred afterwards in other ships. When we first saw it we thought there really were two hulls, and the deception was only removed by the figures gradually uniting, and forming one.\* Captain Bayfield and Mr. Bowen observed five distinct images of another vessel after I left the deck.† When I first noticed extraordinary appearances, like those I have endeavored to describe, I was not aware of the advantage of employing a telescope for the examination of objects at inconsiderable distances. As the whole appeared to be a single image, it seemed extraordinary that the hull of a ship should appear to have its altitude so immensely increased, whilst the masts and sails had their height lessened in an equal, or even greater, degree.‡ A general increase, or a diminution, in the altitude of any object might be reconciled to optical principles, but I could think of no mode that could, in any way, account for the contrary manner, in which the upper and lower parts of the same object seemed to be affected.

It seems probable that the horizontally stratified appearance, which the coast often assumes under this species of mirage, may

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\*The alternate union and separation of the different images, which often occur within a few minutes, cause a very curious variety in the forms which objects seem to assume.

†Since this paper was read we had an opportunity of seeing the form of a ship changed by mirage in a way we had not previously met with. Off Basque Island on the 10th September 1836, at 3 P. M. two ships to the eastward seemed each to consist of three immense columns of irregularly formed sails, with a set of small distinct sails at the top of each column. The images seemed, not only immensely raised, but also extended horizontally (a circumstance which we had not remarked in any previous case) the space between the masts being considerable, and each column of sails quite distinct. The jibs were indistinctly erect and inverted alternately, giving some appearance of a combination of images, but there was no appearance of a hull. (Fig. 7.) The vessels were some miles distant from us, probably hull-down. The temperature of the air was  $47^{\circ}$  water  $39^{\circ}$ . The dew point, found shortly after when a breeze had spring up and the mirage disappeared, was  $37^{\circ}$ .

‡On one occasion, at Bic, what appeared to be a large high boat, with two men sitting on the thwarts, turned out to be a small schooner under sail.

be the effect of multiplied images of the horizon, or level sea at its base. The number of images may as well exceed five, as we find they do three, which, I believe, was the greatest number hitherto noticed by any observer.\*

The temperature of the surface water varies much amongst the Mingan islands. Several rivers empty themselves into the sea at this place, the waters of which, in calms, float on its surface, which thus is sometimes several degrees warmer than the water at a depth of a few inches. A moderate current of air, which amongst small islands is often partial, sometimes, by agitating the water at one place, renders the surface there cold, whilst it continues warm in places sheltered from the wind. We have hence occasionally strange combinations of mirage. On the 16th and 17th July, shortly before the double images of the Perroquet were observed, the islands to the eastward of the harbour had their extremities apparently projecting in the air, as is usual in that species of mirage which depends on the temperature of the surface being higher than that of the air, or at least higher than its dew point. The horizon on this side was low and near—a rock, three miles distant, seemed above it. As the breeze sprung up from the s.w. the horizon receded beyond this rock, and the islands generally appeared to have flattened tops, shewing the mirage of the opposite kind. But the extreme points of the most distant island seemed still in the air, notwithstanding the island generally presented the same flat level top as the others—thus shewing, in its different parts, the opposite forms of mirage at the same time.

Something like this occurs frequently in the strait of Belle-isle, where we saw the Labrador coast exhibiting the flattened tops, walled sides, and other marks of the mirage which is connected with a cold surface, whilst on the Newfoundland side the horizon was depressed, and the points and low shores of the headlands seemed consequently lifted into the air. Whenever we had an opportunity of examining the temperature of the water, on both sides of the strait, we found it warmer near the Newfoundland shore, and the different forms of the mirage, which we saw at other times, seems a proof that it is generally so.†

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\*Whatever the number of images may be, they appear in every instance, to be alternately erect, and inverted.

†The most remarkable mirages over water have occurred in straits: those seen by Mr. Vince at Dover, and the celebrated Fata Morgagna at Messina. In the St. Lawrence they are most frequently observed, and present the greatest varieties in similar situations: as at Bic, Point des Monts, Mingan, and the strait of Belle-isle.

In these cases there was no particular point, which could be fixed on as shewing, that there the effect of either mirage ceased. The raised horizon on the one side, and the depressed horizon on the other, seemed to merge one into the other; and the whole line across the strait appeared unbroken. But on one occasion near the Labrador coast, the point of junction of the two species of mirage was so well marked, that it appeared like a step in the horizon.

On the 18th of June 1834, we were approaching the coast of Labrador from the central parts of the gulf. At 8. 45 A. M. the temperature of the air was  $46^{\circ}$ ; the dew point  $45^{\circ}$ ; the surface water 43. 5; the sky clear; wind s. w, light; barometer 30. 12, rising. The dip of the horizon, from an elevation of 12 ft. 6 inches, was  $3'. 15''$ , by the mean of three very good observations with the dip sector. As we neared the shore, the color of the water changed; the horizon, towards the land, seemed depressed; and the distant islands consequently elevated into the air. About the point where the water changed color, there seemed a sudden descent like a step in the horizon. (Fig. 6.)

At 10. 30 we had got well within the dark discolored water; the air was  $47^{\circ}$  the dew point  $46^{\circ}$ ; the water drawn from along side  $46^{\circ} 5'$ : the wind and sky as before. The dip of the horizon, from the same elevation of 12 ft. 6 inches, was  $4' 11''$ , by the mean of four very distinct equal observations.