A Tortoise inclosed in Ice.

DURING the last winter there was a good deal of correspondence in the columns of *NATURE* regarding the revivability of fish and insects that had been frozen hard. A similar phenomenon with regard to the tortoise having recently come under my notice, it may perhaps be interesting to some of your readers to have it put on record.

Some friends of mine have one of the small water-tortoises that are occasionally exposed for sale in the City. Last winter, this tortoise was inadvertently left in his small pond, the water of which froze completely into one block of ice, inclosing the tortoise. When the thaw came, the creature was found alive and flourishing. I especially endeavoured to ascertain whether the tortoise had been absolutely and completely *inclosed* in his icy casing, or whether he had been simply frozen into the ice, but partly inclosed and partly free. Unfortunately, however, in spite of cross-examining several of the family, I was unable to obtain a perfectly clear and definite statement on this point: one of my friends, however, declared that, if not completely encased, at any rate only the arch of the tortoise's back was free. This is, however, sufficiently indefinite to debar one from asserting that all access of air was denied to the tortoise; and that is the point on which my interest chiefly centred.

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The Soaring of Birds.

I HAVE read with much interest Mr. Peal's account of the soaring of vultures, pelicans, adjutants, &c., over the plain of Upper Assam (*NATURE*, May 21, p. 56). Their manner of flight is identical with that of seagulls and harriers over the Canterbury Plains in New Zealand, which is about 150 miles long and 45 wide in its widest part. These birds begin to soar at a height of about 200 feet, and rise in slanting spirals to 2000 feet and under. The gulls are much the most numerous, and flocks of them may be seen soaring nearly every fine day in summer. Sometimes a number assemble, and after going round in circles for a short time, without rising, or rising very little, they come down, the condition of the air being apparently unfavourable for soaring. Whenever I have seen a flock finish an ascent, they all reached the same height, which is consistent with the supposition that they go as high as they can. They never remained at the limit of their ascent even for a short time, but separated, sailing away downward to great distances.

The explanation of soaring given by Mr. Peal can hardly be the true one. Bishop Courtenay has shown its inadequacy by proving that a bird in a uniform horizontal current is in no respect more able to support himself than in a calm. Though carefully looking for it, I have never been able to see the descent which Mr. Peal supposes to be made (he does not say that he has seen it) when the bird is going with the wind.

The soaring of birds shows plainly that the velocity of the wind over a flat country does not increase with the height in a perceptible degree up to great heights. If there were such an increase at anything like the rate near the ground, a bird soaring would be out of sight long before he could reach 1000 feet, but birds seem to drift horizontally at nearly the same speed during the whole of their ascent. The increase of the velocity of the wind with the height may be studied by observing the behaviour of smoke or steam carried along: near the ground the increase is easily seen, over 20 feet it is very small, over 50 seldom perceptible, a wreath of smoke over that height being carried along without any relative motion of the parts, or so little that it could be of no use in soaring.

In a description of the sailing flight of the albatross (*NATURE*, vol. xl., p. 9) I mentioned that when the wind is at right angles to the course of a steamer attended by a flock of albatrosses, some of them occasionally follow the vessel not far astern in undulating lines, rising against the wind and falling with it, and turning alternately right and left; also that seagulls do an imperfect imitation of this kind of flight over flat country, nearly touching the ground at each descent, as the albatrosses nearly touch the sea. The gulls are evidently unable to reach the height from which the previous descent was made without flapping their wings a few times during the second half of each ascent. Without doing this, they would soon come to the ground, though using the differential motion of the air, where it

is at its maximum, to the greatest advantage possible. It seems, therefore, that soaring at great heights cannot be explained on the same principle as the sailing flight of the albatross, whose movements are confined to a comparatively thin stratum of air next the sea, in which the velocity of the wind increases rapidly with the height.

In Lyttelton Harbour, N.Z., which is surrounded by hills except at the entrance, the gulls soar by using the upward current on the slopes, rising in spirals in precisely the same manner as when soaring hundreds of feet above the plain. The motive power in the former kind of flight is evident, and perhaps throws light on that of the latter. Standing on a slope of about 20°, and about 100 feet above the sea, I saw a flock of gulls sitting on the water. A breeze sprang up, and the whole flock began to ascend over the slope. Being constantly among the shipping they are very tame, and several came within 12 feet of me. When moving against the wind their motion with respect to the earth was very slow, so that I had a good opportunity of seeing if there was any vibratory movement of the wings, but no movement of any kind was visible. The ascent of birds over a slope by means of the current flowing up it, and their descent in long inclines at a small angle with the horizontal, show that rapid motion through the air causes a great resistance in opposition to gravitation, which resistance has not yet, I believe, been accounted for quantitatively on mechanical principles.

The explanation of soaring at great heights which presents the fewest difficulties seems to me to be—that it is done by means of upward currents. This has been suggested by several observers, its main difficulty being the uncertainty that there are such currents of sufficient strength. I shall try to show that upward currents may be caused in two ways, but it would not be possible to give a direct proof that the currents so arising are strong enough. If, however, birds are seen to soar when one or other of these causes is present, there is a strong probability that they are true causes of soaring.

Everyone who has watched the working of a windmill must have seen that the force of the wind varies frequently, and sometimes rather suddenly. It is evident that there must be an ascent of air in front of a current moving faster than the average speed, and a descent of air behind it. As an example of this, a cold south-west wind was blowing, with showers of rain at intervals, accompanied, as often happens, by increased force of the wind. I saw a flock of gulls soaring in front of one of these squalls. There can, I think, be little doubt that there was an ascending current, of which the gulls took advantage.

Mr. W. Ferrel has shown ("Popular Treatise on the Winds") that if the rate of fall of temperature with increase of height be greater than the rate of dynamical cooling of an ascending current, the atmosphere is in an unstable state—that is, if by any cause a mass of air be started in an upward direction in such an atmosphere, the density of the ascending air is less than that of the surrounding still air, so that the former would be driven upwards, and an ascending current established, which would tend to rush up to the top of the atmosphere if the instability, consequent on the vertical decrease of temperature, should extend all the way up; but if the instability did not extend to the top, then, at its limit, the impelling force would cease, and friction would soon bring the ascending current to rest. Conversely, in an unstable atmosphere, if a mass of air be started downward, the density of the descending air is greater than that of the surrounding still air, and the descent tends to continue down to the ground. Mr. Ferrel says (p. 440):—"The unstable state in unsaturated air occurs mostly on very dry and sandy soils with little heat conductivity, when the weather is very warm, and the heat rays of the sun are unobstructed by any clouds above. The heat thus accumulates in the surface strata of the soil and the lower strata of the atmosphere, and thus is brought about the unstable state, at least up to a low altitude, even in clear dry weather." And in speaking of what may be called a multiple tornado (p. 412):—"As the tornado originates in air in the unstable state, it often happens that there is about an equal tendency in the air of the lower stratum to burst up through those above at several places in the same vicinity at the same time."

This tendency of the lower strata to burst up in separate spots may exist where the instability is much less than that required to cause a tornado, as in the case of a plain strongly heated by the sun, and in the absence of any gyratory motion round the centre of an ascending current, there would be no whirlwind, only a