



## THE BIOLOGY OF WINTER

ARGUMENT.—I. An appreciation of the full biological import of Winter is not altogether easy for us, here and now. We must think of peoples with less artificial environment, of more wintry regions, and of Glacial Epochs. II. The Sagas of the Biology of Winter are to be found in such stories as those of the Sleeping Beauty and Balder. III. The astronomical facts bear out our vaguer impressions. IV. Reactions to the cold and scarcity of Winter are very variable:—flight, concealment, colour-change, and so on. V. Hibernation in its varying degrees is a common solution. VI. Yet to many death is inevitable, Winter is the time of intensest elimination. This affects not only individuals, but races. The tree of life grows, but it is also pruned. The only biological consolation is that the fruition of the tree has improved.

### I

**A** TRUE judgment as to the biological import of a Northern Winter is not altogether easy for us, here and now. It is not easy for us, who are cunning and far-sighted, clothed and fire-making organisms; it is not easy here, for, in spite of our grumbling, a British Winter is usually a mild affair; it is not altogether easy now, for our worst winters are but far-off echoes of the Glacial Epoch, when Winter not only conquered Summer, but remained victorious for Ages. Thus it is evident that to do Winter justice we have need to question the Lapps and Samoyedes and other dwellers in the Far North, or, where they have not voices, explorers like Nansen and

Peary; we must think of the Polar Regions, of Alpine life above the snow-line, or of that dark, silent, plantless, intensely cold world—the Deep Sea—where the spell of Winter is unrelieved and perennial; and we must let our imagination travel back to the Ice Ages—the Ages of Horror—during which whole faunas shuddered. Unless we make some such efforts, which we can only now suggest, we are likely to estimate the power of Winter too lightly, and fail in seeing to what degree it casts a spell, often a fatal one, upon life.

## II

A true appreciation of Winter was long since expressed in the story of the Sleeping Beauty. She was richly dowered, we remember, with vigorous beauty and joyous grace, but all her gifts were shadowed by the foreboded doom of early death. Yet by a friendly fairy in reserve, to wit, the residual beneficence of Nature, the doom was transmuted into a kinder spell, which bound her to sleep but not to dying. All care notwithstanding, the spindle pierced her hand, she fell into deep sleep, whence at last the Prince's kiss served for her awakening. Various commentators apart, the meaning seems plain: the Princess was our fair earth with all its glow of life, her youth was Summer—often shadowed—the fatal spindle was the piercing cold, the spell-bound sleep was Winter's long rest, the kiss that awakened was the first strong sunshine of Spring. The beautiful old story is literally one of the 'fairy-tales of Science.'

In the same way, though there is doubtless much else in the myth, we can have no doubt that Balder the Beautiful represented the virility and vitality of the sunny Summer, and that the twig of gloom, the Mistletoe, which flourishes and fruits in Winter, was the emblem of the freezing cold which so often brings sudden death or the quiet peace of sleep. A similar interpretation holds for the not less subtle allegory of Proserpina.

## III

But let us turn from fancy to fact! The astronomers tell us of the general law that on either hemisphere 63 per cent. of the total heat of the year is received during Summer, and 37 per cent. in Winter; but we feel that this statement, fundamental as it is, hardly expresses the full force of the case. First of all, the astronomers are thinking, and, from their point of view, rightly, of a year with only two seasons; therefore, as we are dealing with four, we must refer part of the 37 per cent. received in Winter to late Autumn and part to early Spring, leaving Winter poor indeed. The same authorities also tell us that the length of Summer and Winter is variable; thus we have now 186 days of Summer, and 179 days of Winter (in the two-season sense), while it is but a geological yesterday since in the Ice Ages the Summer lasted for only 166 days, while 199 lay in the grasp of Winter. This is again very important, for the total amount of warmth received has obviously to be divided by the number of days in the season, to give us a numerical expression of the mean daily sun-heat at any given time. Yet finally, this must not hide from us the commonplace of experience that it is not the average temperature which, so to speak, says yea or nay to this or that form of life; it is rather the occurrence of certain maxima and minima, a terrible heat-wave or a week of fatally frosty nights.

## IV

To the cold and scarcity of food which Winter involves in this and more northerly latitudes, there is great variety of reaction on the part of organisms. Of this variety we can only give a few illustrations. Thus most of our birds, emblems of freedom, escape the spell by flight, and, though death is often fleeter still and overtakes them by the way, there can be no doubt that the migration-solution is an effective one. Among those

who are hardy enough, or foolhardy enough, to remain with us, the rate of mortality is often disastrously high.

Other creatures, unequal to the long and adventurous journeys of the birds, retire into winter-quarters, in which they lie low, awaiting happier days. Thus the earthworms burrow more deeply than ever, the lemmings tunnel their winding ways beneath the icy crust of the Tundra, the pupæ and cocoons of insects lie inert in sheltered corners, the frogs bury themselves deeply in the mud, and the slow-worms coil up together in the penetralia of their retreats.

Others, again, such as the Arctic fox, the mountain hare, the ermine, the Hudson's Bay lemming, and the ptarmigan, face the dread enchantment, but turn paler and paler under the spell, until they are white as the snow itself—a safety-giving pallor. It seems likely that a seasonal colour-change of this nature is, in the formal language of the schools, a modification, induced by the cold, but superposed upon a constitutional variation or hereditary predisposition to change. Thus it is well known of Arctic fox and mountain hare, for instance, that the degree of whiteness varies from year to year with the intensity of the Winter. As for its utility, this is at least twofold—the white dress is of service alike in the chase and in flight, while on the other hand it is the warmest dress when the external temperature is less than that of the body.

Man, himself, gets inside other creatures' skins, and bids defiance to weather, or, having in his cunning tapped one of the earth's great stores of energy, sits by the hearth gloating in the warmth of a larger sun than that which now sends him too little cheer. His indifference is, however, in part artificial, as a prolonged coal-strike shows; in part, a privilege of the few, as a glance at the tattered and torn suffices to prove; and in part, merely local, as a short journey northwards convinces us; and he, too, like the birds, often migrates even from our British mildness to a sunnier South, and knows, like many a beast, of winter-refuges, whether in Scottish poor-house or Mentone 'pension.'

To many organisms, both of high and low degree, the alternative comes,—to sleep or die. The spindle cannot be escaped, the cold shall pierce like a sword:—but sleep! and it may be well. Of this sleep there are indeed many degrees, from the mysterious latent-life of frozen seeds and animal germs, to the almost equally mysterious true hibernation of marmot and hedgehog. Often, too, it must be confessed that what began in slumber ends by becoming sleep's twin-sister, Death. Yet, we understand so little of any of these more or less dormant states in their relations to one another, or, indeed, of any one by itself, that we may avoid an analysis which would be inappropriate here, and think of Winter as the sleep-bringer.

The great hypnotist lifts his hands, and the sap stands still in the tree, and the song is hushed in the bird's throat; he makes his passes, and growth ceases in bud and seed, in cocoon and egg; he breathes, and sleep falls upon marmot, hamster, and hedgehog, upon tortoise, frog, and fish, upon snail and insect; he commands—his voice is the North Wind,—and the water stands in the running brooks, and the very waves of the fiord are still. Even in our own mild country, is not the freezing of Loch Fyne upon record?

Apart from the state of latent life—in which a paste-eel, for instance, may lie neither living nor dead for fourteen long years, and seeds for many decennia—there is no form of sleep so near to death as this to which the Wizard of the North commands the true hibernators. Somnolence penetrates to the deep recesses of the creature's being, as the histologist well knows, who tells us of the minute structural changes observed in the cellular elements of the sleeping hedgehog.

The heart beats feebly and intermittently, breathing is at long intervals and very sluggish, the food-canal is empty, income is almost at zero, and expenditure but little more. The sleeper may be immersed in water for twenty minutes, or subjected without apparent result to noxious gases. The fat, accumulated

in days of plenty, is slowly burnt away, sustaining in some measure the animal heat. Yet temperature falls very markedly, to a degree which in ordinary life would be fatal; irritability wanes to a minimum; the ordinary reflexes are at most faint; and the creature steadily loses weight. The wonder is that it keeps alive.

The slumberers differ much in the soundness of their sleep. Thus there are light sleepers, like the dormouse, the harvest mouse, and the squirrel; and heavy sleepers, like hedgehog, hamster, and marmot, or like the tortoise, whom the crack of doom would scarce disturb. Quaint is the somnolence of the mother polar bear, who, after awaking in her snowy couch to give birth to her two cubs, sets them a-sucking, yawns, and falls asleep again. But she, and even the seven sleepers, must yield to the snail who overslept himself so far that when he awoke it was in a case in the British Museum wherein he bore a ticket already many years old. There was another Rip van Winkle snail who awoke to find himself an extinct species, but that, as they say, is another story!

After we allow for the tendency cold has to produce coma, of which Alpine travellers have told us tales; for the drowsiness which is said—let us hope it is true—to take the edge off starvation; for the sleepiness induced, e.g., in church or lecture-room by confined atmosphere, of which no proof is required, there seems to be need of further physiological explanation. It has been suggested, and wisely it seems to us, that the retention of waste-products induces a state of 'auto-intoxication'—a drugging or poisoning of the system with its own excretions, a banking-up of the fire of life with its own ashes. It seems plausible that this will tend to keep the sleepy sleeping, and the idea may be hazarded that one of the reasons why plants are not more wide awake is just this retention of nitrogenous waste-products. For it is well known that plants do not get rid of these. The same is in a measure true of the sea-squirts or Ascidians, which in their adult life are notoriously plant-like and sleepy animals.

The general import of hibernation is in most cases plain. Life saves itself by ceasing to struggle, by retiring within its entrenchments. Death is baffled by a device in which activity virtually ceases without life itself being surrendered. Yet there are other aspects of the Winter's sleep. To some it is a time of repair—a long night—after the nervous fatigue of a longer day. Thus, it is not difficult to understand that, quite apart from the weather, it is good that the queen humble-bee should sleep through the Winter, just as it is well for the fisherman that he should weep after the storm. In short, we return to our main thesis, that life is rhythmic, and that the seasons punctuate it.

To others the sleep is in some measure a preparation for a new day. Thus in the seeds which slumber in the earth, each a young life, there is a rotting away of the husks which the delicate embryo could scarce burst, and later on there are processes of fermentation, by which the legacy of hard, condensed food is made available for the young plant. That it is not merely the unpropitious weather and the hard soil which make it necessary for the seeds to sleep may be proved by experiment, and is also shown by the fact that not a few normally lie dormant for several years. Similarly, within the cocoons there lie the chrysalids, quaintly mummy-like and inert to all appearance, but slowly undergoing that marvellous transformation, the result of which is the winged butterfly—the Psyche.

## VI

It seems a true paradox that one of the great facts in the Biology of Winter is the Frequency of Death. Not that there is any season when Death is not busy, or any opportunity which he does not seize; he winnows among the newborn weaklings of the early Spring, he lays pitfalls for the adolescent, he thins the ranks of Summer's industry, he puts in a full stop at the limit of growth, he forces open the door which love seeks to

keep closed, he harvests in Autumn; but it is in Winter that his power is most felt. It is the time of the least heat, least light, least food; and life hurries on the downgrade to death. The influence on plant-life is most obvious and direct; a large fraction of the income of radiant energy is cut off, the water-supply is also reduced, and there is further risk that the frost cause bursting of cells and vessels within the plant just as in our houses. The diminished vigour of plant-life means less food for the animals, and on them too the relative lack of warmth and light has a directly disastrous effect. Given

‘ A winter such as when birds die  
 In the deep forests, and the fishes lie  
 Stiffened in the translucent ice, which makes  
 Even the mud and slime of the warm lakes  
 A wrinkled clod, as hard as brick,’

the decimating influences are perceptible on every side. Thus of the mortality during the hard winter 1894-95 we have eloquent statistical evidence from moor and forest, lake and seashore. Winter is indeed a time of rest and sleep, but as truly of elimination and death.

Death always means the irrecoverable cessation of bodily life, but it has so many forms—violent, bacterial, and natural,—each, again, with its subdivisions, that we cannot without inquiry say for any particular case that the rate of mortality is greatest in Winter. Yet the general induction appears safe that in our latitude Winter is the time of severest elimination. Thus the season which is apt to seem dull to the field-naturalist is full of interest to the evolutionist. The hedgerows are bare, and the woods silent, the pools are clear and apparently devoid of life, the shore is comparatively barren, even the sea has lost much of its wonted abundance. And, though much of this scarcity is only apparent—life lying low, or asleep, or on a journey—we must allow that it is often altogether sped. Proserpina has gone down to Hades. Balder is dead. We have, in short, to face the inexorable process of natural selection, whereby the

relatively less fit to the conditions of their life tend to be eliminated, i.e. tend to die before the normal time, and to leave behind them less than the normal number of offspring. Winter is the time when the tree of life is most rigorously pruned. In our study of the decadence of Autumn, we spoke of the death of individuals and of the consolation which is offered in the persistence of the race, but we cannot think long over such matters without recognising that the race itself may perish. We need only reverse the hands of the geological clock a few seconds to be convinced of this. We need only go back to the more recent ice-ages—the ages of Winter's tyranny—which are not long past, as time goes. Indeed, we need not leave human or even modern history at all to find sadly abundant illustration of lost races.

Keeping, however, to recent animal history, where are the bears who had their dens in Athole, or the wild boars of the great Caledonian forest, or the busy beavers who cut their logs in the Pass of Killicrankie, or the white bulls who wallowed in the dark waters of the hidden tarns, or the wolves with which Wales paid her tax to King Edgar?

Or, again, where are the early companions and rivals of our forefathers in Britain—the cave-lion, the cave-bear, the cave-hyæna, the shaggy mammoth, and the woolly rhinoceros? Do we know of them at all except in so far as our inheritance includes some of that hardihood, wisdom, and gentleness which they and others helped to work out in man?

Or, going much further back, where are the delicately beautiful graptolites, the quaint trilobites, the great sea-scorpions, the ancient heavily-armoured fishes, the giant amphibians, the monstrous reptiles, the dragons, the toothed birds, the old-fashioned mammals? The most powerful, the most fertile have not been spared, even those which seem as though they had been built not for years but for eternity, have wholly passed away. This is no mere case of leaves falling from off the tree, it is a lopping of branches.

For some of these lost races, competition was doubtless too

keen—they outlived their prosperity and went to the wall ; for others the force of changing circumstances was too strong—they were not plastic enough to change ; for others, perhaps, over-specialisation or feverish activity was fatal ; for others it may be that their constitution was at fault, and that they went down to destruction, as Lucretius finely phrased it, ‘hampered all in their own death-bringing shackles.’ We cannot console ourselves with any vague notion that such disappearance is a misnomer for transmutation into some nobler form ; that may be true of certain species, but it is not true of the wholly extinct races. Nor is there consolation in the notion that the atoms which were once wrapped up in that whilom bundle of life known as the Ichthyosaurus may now be part and parcel of us ; for we feel that those particular combinations which we have called lost races—those smiles of creative genius,—have gone, gone as utterly as the snows of yester year.

Thus from the elimination now observable around us in this wintry season our thoughts naturally pass to the great world-wide process, continuous since life began, which embraces us also in its inexorable sifting. It does not indeed explain us, nor the organisms we know, any more than the pruning-hook explains the tree ; but given life and growth, we cannot understand their history apart from elimination. In short, we need our Winter to explain our Summer, and this perhaps is the only consolation which the biologist can suggest to the discontented—that the history of the world as a whole is the history of a progressive development. The fruition of the tree improves. Perhaps the impersonality of this consolation is the reason why he who was a very Gallio in Summer becomes a religious man in Winter.

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