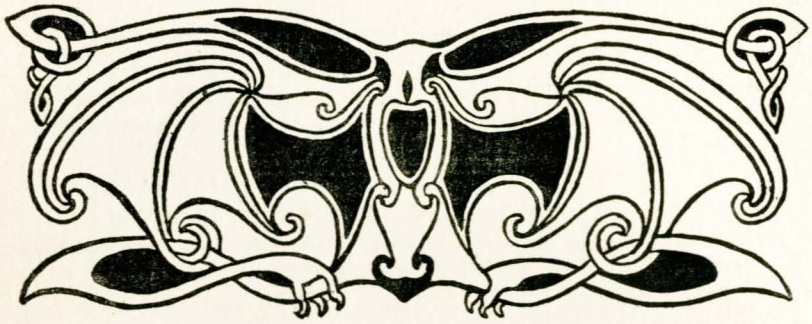

THE BIOLOGY OF AUTUMN

ARGUMENT.—Life is rhythmic and is punctuated by the seasons. The curve of life is undulatory; summer is the crest of the wave, winter the trough, spring and autumn the ascending and descending curves. No one note expresses autumn. It is a time of dying, but the fruits and seeds speak of the abundance and continuance of life. It is a time of withering, decadence, and falling asleep; but also of storing, preparing, and supreme effort. To feel only the sadness of autumn implies a partial view, like that pessimism which exalts itself as a complete philosophy of life.

THE life of plants and animals—and of man himself—is rhythmic. Rest alternates with work, repair with waste, and periods of hunger and self-increase are followed by periods of love and species-continuing. But the internal rhythms, which probably depend on the very nature of living matter, are punctuated by the external rhythms, by day and night, by months and tides, by seasons and cycles of years. Thus we think of an organism as a wave on the sea of life. It rises, grows in strength, breaks, and falls. If it be an annual, summer is an area at the crest of the wave—the limit of its growth and the period of reproduction—winter is an area in the trough; spring and autumn are the ascending and descending curves. Even if the organism be long-lived, it is still a wave—a wave of waves—the seasons marking minor oscillations on the major curve. Moreover, it must be remembered,

though we discern the fact but dimly, that just as the seasons are variable within great cycles of climate-change, so the life of the individual is part of a still larger curve, the life of the species, which also has its periods of rise and progress, of decline and fall.

Just as it was the sun which quickened the seeds, raised the sap, unpacked the buds, and opened the flowers and our hearts as well in spring, so it is the lack of sun which is now casting a spell upon life and making us melancholy in the autumn. But the complexity of the problem lies in the fact that the external changes—more oblique light, a shorter day, increasing cold, and rising storms—act upon living creatures predestined by their protoplasmic nature to be rhythmic. Just as the fatigue of evening and the sleep of night express an external punctuation of an internal rhythm, so is it with the decadence of autumn and the rest of winter.

I

Even the most careless who pause to listen to the curfew of the year must perceive the sadness of the notes, 'Decay, Decay,' 'Farewell and Death.' They are heard in the calls of the passing birds who 'wail their way from cloud to cloud,' in the rustle of falling leaves, and in the piping of a mournful wind which bears birds and leaves away. It is a time of withering and decadence, of leave-taking and death.

But a more careful listener will hear other very different notes, which tell of the continuance of life in spite of death, of preparation for the future amid the withering of the present. The 'farewell' which seemed for ever is more accurately 'Au Revoir.' For the tide of life, which has now turned in ebb, is not one which sinks sullen and empty from a rocky shore; it is rather like that which bears from some great seaport a fleet of richly-laden ships. The ebb of the year is the time when fruits ripen and seeds are scattered, it is not an end, but a new beginning. There is indeed stranding and wreckage, as the dead birds among the jetsam tell us plainly, but the

autumn fruits are more characteristic. They crown the plant's work for the year, and form the cradles of next spring's seedlings; they protect the young lives within the seeds, and also secure their dispersal. Many of them harden, crack, and split like withered leaves, as they often are; others swell and soften into succulence. The nectaries, through which surplus sugars overflowed during flowering, and formed feasts of honey for the bees and other fertilising visitors, have now closed, and the sweetness is drafted into the ripening fruit. Even the fragrance of the flower may be redistilled in the flavour of the fruit, and the cheerful glow of the rosy-cheeked apples is due to the same pigment as that in the withering leaves of the Virginian creeper, or in the gorgeous petals of the viper's bugloss, which is still erect like a standard amid the dead and dying on the moor.

The drops of water rise to the top of the sunlit fountain, enter for a brief moment into the formation of a rainbow, and hurry to the earth again. Such is life. The organism rises to the crest of the wave, reproduces at its limit of growth, and hurries from the climax of loving to the crisis of dying. So all around us in autumn, we see the little child Love holding the door against stalwart Death. The curfew tolls, the fires of life burn low, the lights of love die out, the petals of the last poppy are shed, the butterflies disappear with the sunbeams, Proserpina goes down to Hades—many a man and beast with her—and lowering clouds draw a shroud over the earth. The music of L'Allegro has died away, hushed are Pan's merry pipes, there is no lilt of bird; Il Penseroso begins to prose: 'Dun sky above, brown wastes around you are; from yon horizon dim stalks spectral death.'

But in the very midst of death, one is impressed with the abundance of life. It is the time of seed-scattering. The cotton-grass has unfurled its white sails on the moor, clouds of thistledown and ragwort nutlets with equally dainty parachutes are swept over the waste; the hooked fruits of burdock, cleavers, houndstongue, and how many more, cling to our clothes and to the sheep's fleece; all sorts of pods and capsules

have opened, and gusts of wind—how much more the equinoctial gales—have scattered the seeds. The prodigality is as unmeasurable as it is providential. One oyster survives out of a million embryos; these thistles on the moor are also the elect out of thousands. They survive not so much because they are strong as because they are many, and they are many because it is of the nature of simple life to be prolific. It is a stream which is always overflowing its banks. And so, on this autumn day, the harvest carts pass heavily laden with sheaves, strong coveys of partridges darken the stubble, the links are crowded with rabbits, the air is full of whirling seeds, the apples fall in showers in the orchard, and we wonder, as men have wondered for thousands of years, at the abundance of life.

II

It would be idle to deny that there is in autumn—the fall of the year—an irrepressible note of decadence; it is echoed in a whisper by the rustle of falling leaves. Beneficent in their life, for all the plant's wealth is due to them, they are beautiful in their dying. They have worked themselves out, for it is hardly a metaphor to speak of the industry of the leaf; supplies are running short, the sun's rays are fewer, the first shock of frost has come, and the leaves must die. But before they die they surrender to the plant all that they have still left that is worth having. There is a retreat of particles down the leaf-stalk into the stem. Thus the leaves fall virtually dead, almost empty except of waste. They are like empty houses from which the tenants have flitted, breaking, and burning some of the furnishings as they went, leaving little more than ashes on the hearth. But nature is ever generous of beauty, for the dying leaves have a literal 'beauty for ashes.' Theirs is an euthanasia, and if we are at first inclined with the poets to weep with the withering, listening mournfully to 'the ground whirl of the perished leaves of hope, the wind of death's imperishable wing,' we must learn a deeper plant-lore, that the leaves which by their living have made the plant rich, make it

no poorer when they die, that their flush of death is a prophecy of the petal's glory, for what is a petal but a transfigured leaf? and that even when fallen they may serve as cradle-clothes for next year's seedlings. The fact remains that just as the progressive life of the species demands the death of individuals, and is within limits unmoved thereby, so the forest-tree, fit emblem of Igdrasil, lives strongly on though the leaves fall from its thousand branches.

III

We hear another note of autumn when we listen to the calls of the migratory birds as they pass overhead by night or congregate with excited clamouring before starting. It is the note of autumnal restlessness. Many little spiders feel it and pass from field to field on silken parachutes of gossamer which the Germans call 'Der fliegende Sommer.' There are also strange autumnal flights of certain beetles and moths, the deer leave the heights for the low ground, and the Greenland seal comes south to Iceland. Man himself feels it, for how many pilgrims are there at this season who journey southward seeking the sun.

Most sensitive, however, to the breath of approaching winter, and to hints of scarcity, are the birds whose presence made the summer glad. Many are already gone, for the tide turned in midsummer; 'the last spent pulses of the great vernal wave of migration have scarcely ceased to flow before the first ripples of the autumn tide begin to be apparent.' Many have slipped away, singly or in pairs, without a good-bye; others are still making up their minds, making many last appearances, telling us excitedly day after day, 'We are going, we are going!'

That they should go we do not wonder, for the leaves are falling from the trees shaken by the cold winds, the fruits have been gathered or scattered, the seeds are sown, most insects are dead or in safe resting places. We draw our cloak about us shiveringly, as we wish the last swallows 'Bon Voyage.'

The history of the habit is wrapped up with the evolution of climates; thus many see in the autumnal retreat a reminiscence

of the Ages of Horror—which made whole faunas shudder—the Glacial Epochs. The impulse to migrate seems to be inborn or instinctive, for even comfortably caged birds beat their wings restlessly when the time of wandering draws near; moreover, after we have allowed all we dare allow to experience, education, and social tradition, we have still to fall back on the supposition that the power of migrating successfully is also in great part inborn. In other words, it seems that a sense of direction, developed in many animals, not yet wholly lost in man, has been brought to perfection in birds.

Of all pilgrimages—and there are many animals who travel, such as reindeer and lemmings, whales and seals, salmon and sturgeon,—this of birds is certainly the most marvellous. Picture the rush of the feathered tide, spreading for many square miles in the heavens, continuing for days at a time without interruption.

> 'Who can recount what transmigrations there
> Are annual made? What nations come and go?
> And how the living clouds on clouds arise?
> Infinite wings! till all the plume-dark air,
> And rude resounding shore, are one wild cry.'

Think of the velocity of the flight, an exaltation of the birds' usual powers, often far exceeding a hundred miles an hour. Thus the dotterel is said to sup at sunset on the North African steppes, and breakfast next morning on the Arctic Tundra; and the Virginian plover is said to pass in one long flight of fifteen hours from Labrador to North Brazil. Consider the extent of the migration, often ten thousand miles, and it may even be from the Arctic Ocean to New Zealand; the breadth of the flying phalanx which may simultaneously strike upon British shores from the Channel Islands to the Shetlands; the altitude of the flight which seems often to be conducted in the rare calm air found at an elevation of ten thousand feet or more. Realise the difficulties of a journey over the pathless sea and in the darkness of night. Contrast the 'wild mad rush' of spring, when the birds fly northwards and eastwards,

at their utmost speed, by the shortest route, and almost without a break, as if love called them clamantly, with the less urgent westerly and southerly flight in autumn when the young birds, reversing the spring order, are the first to leave and often linger by the way. Nor forbid the shadow which falls over the picture, but remember of the birds as they fly that theirs is 'no pleasant path in the wake of retreating summer or in the van of advancing spring,' for migration is the great effort of their life, and to many it is the last. Must we not confess that the swallow flying south is 'too wonderful for us'?

IV

Some one has defined life as a slow dying. For apart from the quasi-immortal Protists, whose simplicity makes it possible for them to make good their waste by constant and perfect repair, organisms always tend more or less rapidly to run into physiological debt to themselves. Autumn is the time for balancing accounts, and then Death often claims what Love has placed in pawn. Thus of the wasps whose nuptial flight we observed one of those harvest-days, the drone-lovers are already dead, their mates have found sheltered nooks for maternal and hibernal slumbers, and the residue, almost automatic Spartans, have turned out all the remaining grubs from their cradles, and are themselves awaiting death in the first night's frost.

Life has also been described as a struggle to avoid death, or as an effort towards continuance, and here again there is truth. For apart from parasites, who live in drifting ease, life means effort and struggle between the poles of love and hunger. We miss part of the biology of autumn if we do not recognise it as a time of preparation for continued life.

The plant has been storing all summer, and now the reserves pass from the more perishable parts, from leaf to stem, from stem to root. There are stores in many buds, well-protected by scales which, dying away, save the delicate life within; there are stores in seeds, similarly protected by dead husks; and so is it with tuber and root-stock, corm and bulb, all are stores.

The beavers store branches, the squirrels nuts, the field-mice grain, the mole worms, and so on through a long list. Hundreds of insects have stored provender for offspring which they will not survive to see. Some ants store grain, biting at the embryo and thus preventing germination; a few take their cows—the aphides—with them into winter-quarters. It is said that hive-bees become lazy in countries where there is practically no winter, which corroborates the suggestion that the success of north temperate peoples is partly due to that discipline in foresight, as well as to the emphatic punctuation of life, which the marked seasonal changes impose.

Autumn is the evening of the year, the beginning of rest, and we must correct the oppressive vision of a dying world with a thought of the reparation which is given in sleep. The trees, some of them already bare, the inert buds formed some months ago on the boughs, the seeds buried in the ground, the chrysalids hidden in quiet resting-places, the eggs and larvæ under the still waters, the lethargic frogs in the mud of the pond, the reptiles and mammals who have found their winter nests—they are not dead but sleeping. They await the good-morning of another spring, and though to some this never comes, of most it may be said that if they sleep, they shall do well.

V

'As is the world on the banks, so is the mind of man,' and no one at all sensitive can avoid a feeling of sadness in autumn. For some, indeed, this is apt to sink into pessimism. Of this as a philosophic system, the biologist has nothing to say—it is probably as good as another. He is too matter-of-fact a person to understand the philosopher's dictum—'This is the best of all possible worlds, but it is worse than none at all.' Nor would he disturb those who enjoy the comforts of pessimism, which consist, according to Von Hartmann, in being completely disillusioned as to the present, and in contemplating the painlessness of the no-life to come. The biologist knows, however, that those who find only pessimism

in autumn, have been but partial students of the season, and he fancies that this may be true of larger things. He would rest on the fact that the tree stands while the leaves fall, that there is fruition in the midst of decadence, and continuance of life in the midst of death. He knows that the apparent 'Vergehen' is the beginning and condition of a new 'Werden.' Even when dying he sees as much as he wants of himself living on in his children. His vision of the past shows a cumulative progress of things, and gives him a sustaining hope for the future; and his evolutionary postulate that there is nothing in the end which was not also in the beginning expresses his speechless faith that in the beginning was the Logos.

Climb the hill above the village, and watch the sun set over the withering woods. Look out over the sea of gold, mingled with fire, and broken by dark rocks which you know to be pines. Accept the withering but see also the harvest-fields; even on the bare boughs there are buds. Hear the birds pass overhead, quite a Babel of good-byes, but many at least will return. Watch the seeds drift off the dead plants as the wind sighs along the hillside, and know that the race continues. Look death in the face, and see that he is kindly and wise. Wait till the cows are driven home lowing, till the sheep are herded off the exposed moorland, till the colours pale in the brief twilight, till the birds that remain cease to sing, till the lamps are lit in the cottage windows. Wait on till the curfew tolls, till the lights are put out one by one,—then know the rest and silence of autumn.

'Ueber allen Gipfeln
Ist Ruh,
In allen Wipfeln
Spürest du
Kaum einen Hauch;
Die Vögelein schweigen im Walde.
Warte nur, balde
Ruhest du auch.'

J. ARTHUR THOMSON.