ALLEN GRANT

FALLING IN LOVE; WITH OTHER ESSAYS ON MORE EXACT BRANCHES OF SCIENCE

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Allen G.

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Содержание

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PREFACE

Some people complain that science is dry. That is, of course, a matter of taste. For my own part, I like my science and my champagne as dry as I can get them. But the public thinks otherwise. So I have ventured to sweeten accompanying samples as far as possible to suit the demand, and trust they will meet with the approbation of consumers.

Of the specimens here selected for exhibition, my title piece originally appeared in the *Fortnightly Review*: 'Honey Dew' and 'The First Potter' were contributions to *Longman's Magazine*: and all the rest found friendly shelter between the familiar yellow covers of the good old *Cornhill*. My thanks are due to the proprietors and editors of those various periodicals for kind permission to reproduce them here.

G.A.

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FALLING IN LOVE

An ancient and famous human institution is in pressing danger. Sir George Campbell has set his face against the time-honoured practice of Falling in Love. Parents innumerable, it is true, have set their faces against it already from immemorial antiquity; but then they only attacked the particular instance, without venturing to impugn the institution itself on general principles. An old Indian administrator, however, goes to work in all things on a different pattern. He would always like to regulate human life generally as a department of the India Office; and so Sir George Campbell would fain have husbands and wives selected for one another (perhaps on Dr. Johnson's principle, by the Lord Chancellor) with a view to the future development of the race, in the process which he not very felicitously or elegantly describes as 'man-breeding.' 'Probably,' he says, as reported in *Nature*, 'we have enough physiological knowledge to effect a vast improvement in the pairing of individuals of the same or allied races if we could only apply that knowledge to make fitting marriages, instead of giving way to foolish ideas about love and the tastes of young people, whom we can hardly trust to choose their own bonnets, much less to choose in a graver matter in which they are most likely to be influenced by frivolous prejudices.' He wants us, in other words, to discard the deep-seated inner physiological promptings of inherited instinct, and to substitute for them some calm and dispassionate but artificial selection of a fitting partner as the father or mother of future generations.

Now this is of course a serious subject, and it ought to be treated seriously and reverently. But, it seems to me, Sir George Campbell's conclusion is exactly the opposite one from the conclusion now being forced upon men of science by a study of the biological and psychological elements in this very complex problem of heredity. So far from considering love as a 'foolish idea,' opposed to the best interests of the race, I believe most competent physiologists and psychologists, especially those of the modern evolutionary school, would regard it rather as an essentially beneficent and conservative instinct developed and maintained in us by natural causes, for the very purpose of insuring just those precise advantages and improvements which Sir George Campbell thinks he could himself effect by a conscious and deliberate process of selection. More than that, I believe, for my own part (and I feel sure most evolutionists would cordially agree with me), that this beneficent inherited instinct of Falling in Love effects the object it has in view far more admirably, subtly, and satisfactorily, on the average of instances, than any clumsy human selective substitute could possibly effect it.

In short, my doctrine is simply the old-fashioned and confiding belief that marriages are made in heaven: with the further corollary that heaven manages them, one time with another, a great deal better than Sir George Campbell.

Let us first look how Falling in Love affects the standard of human efficiency; and then let us consider what would be the probable result of any definite conscious attempt to substitute for it some more deliberate external agency.

Falling in Love, as modern biology teaches us to believe, is nothing more than the latest, highest, and most involved exemplification, in the human race, of that almost universal selective process which Mr. Darwin has enabled us to recognise throughout the whole long series of the animal kingdom. The butterfly that circles and eddies in his aërial dance around his observant mate is endeavouring to charm her by the delicacy of his colouring, and to overcome her coyness by the display of his skill. The peacock that struts about in imperial pride under the eyes of his attentive hens, is really contributing to the future beauty and strength of his race by collecting to himself a harem through whom he hands down to posterity the valuable qualities which have gained the admiration of his mates in his own person. Mr. Wallace has shown that to be beautiful is to be efficient; and sexual selection is thus, as it were, a mere lateral form of natural selection—a survival of the fittest in the guise of mutual attractiveness and mutual adaptability, producing on the average a maximum of the best properties of the race in the resulting offspring. I need not dwell here upon this aspect of the

case, because it is one with which, since the publication of the 'Descent of Man,' all the world has been sufficiently familiar.

In our own species, the selective process is marked by all the features common to selection throughout the whole animal kingdom; but it is also, as might be expected, far more specialised, far more individualised, far more cognisant of personal traits and minor peculiarities. It is furthermore exerted to a far greater extent upon mental and moral as well as physical peculiarities in the individual.

We cannot fall in love with everybody alike. Some of us fall in love with one person, some with another. This instinctive and deep-seated differential feeling we may regard as the outcome of complementary features, mental, moral, or physical, in the two persons concerned; and experience shows us that, in nine cases out of ten, it is a reciprocal affection, that is to say, in other words, an affection roused in unison by varying qualities in the respective individuals.

Of its eminently conservative and even upward tendency very little doubt can be reasonably entertained. We *do* fall in love, taking us in the lump, with the young, the beautiful, the strong, and the healthy; we do *not* fall in love, taking us in the lump, with the aged, the ugly, the feeble, and the sickly. The prohibition of the Church is scarcely needed to prevent a man from marrying his grandmother. Moralists have always borne a special grudge to pretty faces; but, as Mr. Herbert Spencer admirably put it (long before the appearance of Darwin's selective theory), 'the saying that beauty is but skin-deep is itself but a skin-deep saying.' In reality, beauty is one of the very best guides we can possibly have to the desirability, so far as race-preservation is concerned, of any man or any woman as a partner in marriage. A fine form, a good figure, a beautiful bust, a round arm and neck, a fresh complexion, a lovely face, are all outward and visible signs of the physical qualities that on the whole conspire to make up a healthy and vigorous wife and mother; they imply soundness, fertility, a good circulation, a good digestion. Conversely, sallowness and paleness are roughly indicative of dyspepsia and anæmia; a flat chest is a symptom of deficient maternity; and what we call a bad figure is really, in one way or another, an unhealthy departure from the central norma and standard of the race. Good teeth mean good deglutition; a clear eye means an active liver; scrubbiness and undersizedness mean feeble virility. Nor are indications of mental and moral efficiency by any means wanting as recognised elements in personal beauty. A good-humoured face is in itself almost pretty. A pleasant smile half redeems unattractive features. Low, receding foreheads strike us unfavourably. Heavy, stolid, half-idiotic countenances can never be beautiful, however regular their lines and contours. Intelligence and goodness are almost as necessary as health and vigour in order to make up our perfect ideal of a beautiful human face and figure. The Apollo Belvedere is no fool; the murderers in the Chamber of Horrors at Madame Tussaud's are for the most part no beauties.

What we all fall in love with, then, as a race, is in most cases efficiency and ability. What we each fall in love with individually is, I believe, our moral, mental, and physical complement. Not our like, not our counterpart; quite the contrary; within healthy limits, our unlike and our opposite. That this is so has long been more or less a commonplace of ordinary conversation; that it is scientifically true, one time with another, when we take an extended range of cases, may, I think, be almost demonstrated by sure and certain warranty of human nature.

Brothers and sisters have more in common, mentally and physically, than any other members of the same race can possibly have with one another. But nobody falls in love with his sister. A profound instinct has taught even the lower races of men (for the most part) to avoid such union of the all-but-identical. In the higher races the idea never so much as occurs to us. Even cousins seldom fall in love—seldom, that is to say, in comparison with the frequent opportunities of intercourse they enjoy, relatively to the remainder of general society. When they do, and when they carry out their perilous choice effectively by marriage, natural selection soon avenges Nature upon the offspring by cutting off the idiots, the consumptives, the weaklings, and the cripples, who often result from such consanguineous marriages. In narrow communities, where breeding in-and-in becomes almost inevitable, natural selection has similarly to exert itself upon a crowd of *crétins* and other hapless

incapables. But in wide and open champaign countries, where individual choice has free room for exercise, men and women as a rule (if not constrained by parents and moralists) marry for love, and marry on the whole their natural complements. They prefer outsiders, fresh blood, somebody who comes from beyond the community, to the people of their own immediate surroundings. In many men the dislike to marrying among the folk with whom they have been brought up amounts almost to a positive instinct; they feel it as impossible to fall in love with a fellow-townswoman as to fall in love with their own first cousins. Among exogamous tribes such an instinct (aided, of course, by other extraneous causes) has hardened into custom; and there is reason to believe (from the universal traces among the higher civilisations of marriage by capture) that all the leading races of the world are ultimately derived from exogamous ancestors, possessing this healthy and excellent sentiment.

In minor matters, it is of course universally admitted that short men, as a rule, prefer tall women, while tall men admire little women. Dark pairs by preference with fair; the commonplace often runs after the original. People have long noticed that this attraction towards one's opposite tends to keep true the standard of the race; they have not, perhaps, so generally observed that it also indicates roughly the existence in either individual of a desire for its own natural complement. It is difficult here to give definite examples, but everybody knows how, in the subtle psychology of Falling in Love, there are involved innumerable minor elements, physical and mental, which strike us exactly because of their absolute adaptation to form with ourselves an adequate union. Of course we do not definitely seek out and discover such qualities; instinct works far more intuitively than that; but we find at last, by subsequent observation, how true and how trustworthy were its immediate indications. That is to say, those men do so who were wise enough or fortunate enough to follow the earliest promptings of their own hearts, and not to be ashamed of that divinest and deepest of human intuitions, love at first sight.

How very subtle this intuition is, we can only guess in part by the apparent capriciousness and incomprehensibility of its occasional action. We know that some men and women fall in love easily, while others are only moved to love by some very special and singular combination of peculiarities. We know that one man is readily stirred by every pretty face he sees, while another man can only be roused by intellectual qualities or by moral beauty. We know that sometimes we meet people possessing every virtue and grace under heaven, and yet for some unknown and incomprehensible reason we could no more fall in love with them than we could fall in love with the Ten Commandments. I don't, of course, for a moment accept the silly romantic notion that men and women fall in love only once in their lives, or that each one of us has somewhere on earth his or her exact affinity, whom we must sooner or later meet or else die unsatisfied. Almost every healthy normal man or woman has probably fallen in love over and over again in the course of a lifetime (except in case of very early marriage), and could easily find dozens of persons with whom they would be capable of falling in love again if due occasion offered. We are not all created in pairs, like the Exchequer tallies, exactly intended to fit into one another's minor idiosyncrasies. Men and women as a rule very sensibly fall in love with one another in the particular places and the particular societies they happen to be cast among. A man at Ashby-de-la-Zouch does not hunt the world over to find his pre-established harmony at Paray-le-Monial or at Denver, Colorado. But among the women he actually meets, a vast number are purely indifferent to him; only one or two, here and there, strike him in the light of possible wives, and only one in the last resort (outside Salt Lake City) approves herself to his inmost nature as the actual wife of his final selection.

Now this very indifference to the vast mass of our fellow-countrymen or fellow-countrywomen, this extreme pitch of selective preference in the human species, is just one mark of our extraordinary specialisation, one stamp and token of our high supremacy. The brutes do not so pick and choose, though even there, as Darwin has shown, selection plays a large part (for the very butterflies are coy, and must be wooed and won). It is only in the human race itself that selection descends into such minute, such subtle, such indefinable discriminations. Why should a universal and common impulse have in our case these special limits? Why should we be by nature so fastidious and so diversely

affected? Surely for some good and sufficient purpose. No deep-seated want of our complex life would be so narrowly restricted without a law and a meaning. Sometimes we can in part explain its conditions. Here, we see that beauty plays a great *rôle*; there, we recognise the importance of strength, of manner, of grace, of moral qualities. Vivacity, as Mr. Galton justly remarks, is one of the most powerful among human attractions, and often accounts for what might otherwise seem unaccountable preferences. But after all is said and done, there remains a vast mass of instinctive and inexplicable elements: a power deeper and more marvellous in its inscrutable ramifications than human consciousness. 'What on earth,' we say, 'could So-and-so see in So-and-so to fall in love with?' This very inexplicability I take to be the sign and seal of a profound importance. An instinct so conditioned, so curious, so vague, so unfathomable, as we may guess by analogy with all other instincts, must be Nature's guiding voice within us, speaking for the good of the human race in all future generations.

On the other hand, let us suppose for a moment (impossible supposition!) that mankind could conceivably divest itself of 'these foolish ideas about love and the tastes of young people,' and could hand over the choice of partners for life to a committee of anthropologists, presided over by Sir George Campbell. Would the committee manage things, I wonder, very much better than the Creator has managed them? Where would they obtain that intimate knowledge of individual structures and functions and differences which would enable them to join together in holy matrimony fitting and complementary idiosyncrasies? Is a living man, with all his organs, and powers, and faculties, and dispositions, so simple and easy a problem to read that anybody else can readily undertake to pick out off-hand a help meet for him? I trow not! A man is not a horse or a terrier. You cannot discern his 'points' by simple inspection. You cannot see *à priori* why a Hanoverian bandsman and his heavy, ignorant, uncultured wife, should conspire to produce a Sir William Herschel. If you tried to improve the breed artificially, either by choice from outside, or by the creation of an independent moral sentiment, irrespective of that instinctive preference which we call Falling in Love, I believe that so far from improving man, you would only do one of two things—either spoil his constitution, or produce a tame stereotyped pattern of amiable imbecility. You would crush out all initiative, all spontaneity, all diversity, all originality; you would get an animated moral code instead of living men and women.

Look at the analogy of domestic animals. That is the analogy to which breeding reformers always point with special pride: but what does it really teach us? That you can't improve the efficiency of animals in any one point to any high degree, without upsetting the general balance of their constitution. The race-horse can run a mile on a particular day at a particular place, bar accidents, with wonderful speed: but that is about all he is good for. His health as a whole is so surprisingly feeble that he has to be treated with as much care as a delicate exotic. 'In regard to animals and plants,' says Sir George Campbell, 'we have very largely mastered the principles of heredity and culture, and the modes by which good qualities may be maximised, bad qualities minimised.' True, so far as concerns a few points prized by ourselves for our own purposes. But in doing this, we have so lowered the general constitutional vigour of the plants or animals that our vines fall an easy prey to oidium and phylloxera, our potatoes to the potato disease and the Colorado beetle; our sheep are stupid, our rabbits idiotic, our domestic breeds generally threatened with dangers to life and limb unknown to their wiry ancestors in the wild state. And when one comes to deal with the infinitely more complex individuality of man, what hope would there be of our improving the breed by deliberate selection? If we developed the intellect, we would probably stunt the physique or the moral nature; if we aimed at a general culture of all faculties alike, we would probably end by a Chinese uniformity of mediocre dead level.

The balance of organs and faculties in a race is a very delicate organic equilibrium. How delicate we now know from thousands of examples, from the correlations of seemingly unlike parts, from the wide-spread effects of small conditions, from the utter dying out of races like the Tasmanians or the Paraguay Indians under circumstances different from those with which their ancestors were

familiar. What folly to interfere with a marvellous instinct which now preserves this balance intact, in favour of an untried artificial system which would probably wreck it as helplessly as the modern system of higher education for women is wrecking the maternal powers of the best class in our English community!

Indeed, within the race itself, as it now exists, free choice, aided by natural selection, is actually improving every good point, and is for ever weeding out all the occasional failures and shortcomings of nature. For weakly children, feeble children, stupid children, heavy children, are undoubtedly born under this very régime of falling in love, whose average results I believe to be so highly beneficial. How is this? Well, one has to take into consideration two points in seeking for the solution of that obvious problem.

In the first place, no instinct is absolutely perfect. All of them necessarily fail at some points. If on the average they do good, they are sufficiently justified. Now the material with which you have to start in this case is not perfect. Each man marries, even in favourable circumstances, not the abstractly best adapted woman in the world to supplement or counteract his individual peculiarities, but the best woman then and there obtainable for him. The result is frequently far from perfect; all I claim is that it would be as bad or a good deal worse if somebody else made the choice for him, or if he made the choice himself on abstract biological and 'eugenic' principles. And, indeed, the very existence of better and worse in the world is a condition precedent of all upward evolution. Without an overstocked world, with individual variations, some progressive, some retrograde, there could be no natural selection, no survival of the fittest. That is the chief besetting danger of cut-and-dried doctrinaire views. Malthus was a very great man; but if his principle of prudential restraint were fully carried out, the prudent would cease to reproduce their like, and the world would be peopled in a few generations by the hereditarily reckless and dissolute and imprudent. Even so, if eugenic principles were universally adopted, the chance of exceptional and elevated natures would be largely reduced, and natural selection would be in so much interfered with or sensibly retarded.

In the second place, again, it must not be forgotten that falling in love has never yet, among civilised men at least, had a fair field and no favour. Many marriages are arranged on very different grounds—grounds of convenience, grounds of cupidity, grounds of religion, grounds of snobbishness. In many cases it is clearly demonstrable that such marriages are productive in the highest degree of evil consequences. Take the case of heiresses. An heiress is almost by necessity the one last feeble and flickering relic of a moribund stock—often of a stock reduced by the sordid pursuit of ill-gotten wealth almost to the very verge of actual insanity. But let her be ever so ugly, ever so unhealthy, ever so hysterical, ever so mad, somebody or other will be ready and eager to marry her on any terms. Considerations of this sort have helped to stock the world with many feeble and unhealthy persons. Among the middle and upper classes it may be safely said only a very small percentage of marriages is ever due to love alone; in other words, to instinctive feeling. The remainder have been influenced by various side advantages, and nature has taken her vengeance accordingly on the unhappy offspring. Parents and moralists are ever ready to drown her voice, and to counsel marriage within one's own class, among nice people, with a really religious girl, and so forth *ad infinitum*. By many well-meaning young people these deadly interferences with natural impulse are accepted as part of a higher and nobler law of conduct. The wretched belief that one should subordinate the promptings of one's own soul to the dictates of a miscalculating and misdirecting prudence has been instilled into the minds of girls especially, until at last many of them have almost come to look upon their natural instincts as wrong, and the immoral, race-destructive counsels of their seniors or advisers as the truest and purest earthly wisdom. Among certain small religious sects, again, such as the Quakers, the duty of 'marrying in' has been strenuously inculcated, and only the stronger-minded and more individualistic members have had courage and initiative enough to disregard precedent, and to follow the internal divine monitor, as against the externally-imposed law of their particular community. Even among wider bodies it is commonly held that Catholics must not marry Protestants; and the admirable results

obtained by the mixture of Jewish with European blood have almost all been reached by male Jews having the temerity to marry 'Christian' women in the face of opposition and persecution from their co-nationalists. It is very rarely indeed that a Jewess will accept a European for a husband. In so many ways, and on so many grounds, does convention interfere with the plain and evident dictates of nature.

Against all such evil parental promptings, however, a great safeguard is afforded to society by the wholesome and essentially philosophical teaching of romance and poetry. I do not approve of novels. They are for the most part a futile and unprofitable form of literature; and it may profoundly be regretted that the mere blind laws of supply and demand should have diverted such an immense number of the ablest minds in England, France, and America, from more serious subjects to the production of such very frivolous and, on the whole, ephemeral works of art. But the novel has this one great counterpoise of undoubted good to set against all the manifold disadvantages and shortcomings of romantic literature—that it always appeals to the true internal promptings of inherited instinct, and opposes the foolish and selfish suggestions of interested outsiders. It is the perpetual protest of poor banished human nature against the expelling pitchfork of calculating expediency in the matrimonial market. While parents and moralists are for ever saying, 'Don't marry for beauty; don't marry for inclination; don't marry for love: marry for money, marry for social position, marry for advancement, marry for our convenience, not for your own,' the romance-writer is for ever urging, on the other hand, 'Marry for love, and for love only.' His great theme in all ages has been the opposition between parental or other external wishes and the true promptings of the young and unsophisticated human heart. He has been the chief ally of sentiment and of nature. He has filled the heads of all our girls with what Sir George Campbell describes off-hand as 'foolish ideas about love.' He has preserved us from the hateful conventions of civilisation. He has exalted the claims of personal attraction, of the mysterious native yearning of heart for heart, of the indefinite and indescribable element of mutual selection; and, in so doing, he has unconsciously proved himself the best friend of human improvement and the deadliest enemy of all those hideous 'social lies which warp us from the living truth.' His mission is to deliver the world from Dr. Johnson and Sir George Campbell.

For, strange to say, it is the moralists and the doctrinaires who are always in the wrong: it is the sentimentalists and the rebels who are always in the right in this matter. If the common moral maxims of society could have had their way—if we had all chosen our wives and our husbands, not for their beauty or their manliness, not for their eyes or their moustaches, not for their attractiveness or their vivacity, but for their 'sterling qualities of mind and character,' we should now doubtless be a miserable race of prigs and bookworms, of martinets and puritans, of nervous invalids and feeble idiots. It is because our young men and maidens will not hearken to these penny-wise apophthegms of shallow sophistry—because they often prefer *Romeo and Juliet* to the 'Whole Duty of Man,' and a beautiful face to a round balance at Coutts's—that we still preserve some vitality and some individual features, in spite of our grinding and crushing civilisation. The men who marry balances, as Mr. Galton has shown, happily die out, leaving none to represent them: the men who marry women they have been weak enough and silly enough to fall in love with, recruit the race with fine and vigorous and intelligent children, fortunately compounded of the complementary traits derived from two fairly contrasted and mutually reinforcing individualities.

I have spoken throughout, for argument's sake, as though the only interest to be considered in the married relation were the interests of the offspring, and so ultimately of the race at large, rather than of the persons themselves who enter into it. But I do not quite see why each generation should thus be sacrificed to the welfare of the generations that afterwards succeed it. Now it is one of the strongest points in favour of the system of falling in love that it does, by common experience in the vast majority of instances, assort together persons who subsequently prove themselves thoroughly congenial and helpful to one another. And this result I look upon as one great proof of the real value and importance of the instinct. Most men and women select for themselves partners for life at an age when they know but little of the world, when they judge but superficially of characters and motives,

when they still make many mistakes in the conduct of life and in the estimation of chances. Yet most of them find in after days that they have really chosen out of all the world one of the persons best adapted by native idiosyncrasy to make their joint lives enjoyable and useful. I make every allowance for the effects of habit, for the growth of sentiment, for the gradual approximation of tastes and sympathies; but surely, even so, it is a common consciousness with every one of us who has been long married, that we could hardly conceivably have made ourselves happy with any of the partners whom others have chosen; and that we have actually made ourselves so with the partners we chose for ourselves under the guidance of an almost unerring native instinct. Yet adaptation between husband and wife, so far as their own happiness is concerned, can have had comparatively little to do with the evolution of the instinct, as compared with adaptation for the joint production of vigorous and successful offspring. Natural selection lays almost all the stress on the last point, and hardly any at all upon the first one. If, then, the instinct is found on the whole so trustworthy in the minor matter, for which it has not specially been fashioned, how far more trustworthy and valuable must it probably prove in the greater matter—greater, I mean, as regards the interests of the race—for which it has been mainly or almost solely developed!

I do not doubt that, as the world goes on, a deeper sense of moral responsibility in the matter of marriage will grow up among us. But it will not take the false direction of ignoring these our profoundest and holiest instincts. Marriage for money may go; marriage for rank may go; marriage for position may go; but marriage for love, I believe and trust, will last for ever. Men in the future will probably feel that a union with their cousins or near relations is positively wicked; that a union with those too like them in person or disposition is at least undesirable; that a union based upon considerations of wealth or any other consideration save considerations of immediate natural impulse, is base and disgraceful. But to the end of time they will continue to feel, in spite of doctrinaires, that the voice of nature is better far than the voice of the Lord Chancellor or the Royal Society; and that the instinctive desire for a particular helpmate is a surer guide for the ultimate happiness, both of the race and of the individual, than any amount of deliberate consultation. It is not the foolish fancies of youth that will have to be got rid of, but the foolish, wicked, and mischievous interference of parents or outsiders.

RIGHT AND LEFT

Adult man is the only animal who, in the familiar scriptural phrase, 'knoweth the right hand from the left.' This fact in his economy goes closely together with the other facts, that he is the only animal on this sublunary planet who habitually uses a knife and fork, articulate language, the art of cookery, the common pump, and the musical glasses. His right-handedness, in short, is part cause and part effect of his universal supremacy in animated nature. He is what he is, to a great extent, 'by his own right hand;' and his own right hand, we may shrewdly suspect, would never have differed at all from his left were it not for the manifold arts and trades and activities he practises.

It was not always so, when wild in woods the noble savage ran. Man was once, in his childhood on earth, what Charles Reade wanted him again to be in his maturer centuries, ambidextrous. And lest any lady readers of this volume—in the Cape of Good Hope, for example, or the remoter portions of the Australian bush, whither the culture of Girton and the familiar knowledge of the Latin language have not yet penetrated—should complain that I speak with unknown tongues, I will further explain for their special benefit that ambidextrous means equally-handed, using the right and the left indiscriminately. This, as Mr. Andrew Lang remarks in immortal verse, 'was the manner of Primitive Man.' He never minded twopence which hand he used, as long as he got the fruit or the scalp he wanted. How could he when twopence wasn't yet invented? His mamma never said to him in early youth, 'Why-why,' or 'Tomtom,' as the case might be, 'that's the wrong hand to hold your flint-scraper in.' He grew up to man's estate in happy ignorance of such minute and invidious distinctions between his anterior extremities. Enough for him that his hands could grasp the forest boughs or chip the stone into shapely arrows; and he never even thought in his innocent soul which particular hand he did it with.

How can I make this confident assertion, you ask, about a gentleman whom I never personally saw, and whose habits the intervention of five hundred centuries has precluded me from studying at close quarters? At first sight, you would suppose the evidence on such a point must be purely negative. The reconstructive historian must surely be inventing *à priori* facts, evolved, *more Germanico*, from his inner consciousness. Not so. See how clever modern archæology has become! I base my assertion upon solid evidence. I know that Primitive Man was ambidextrous, because he wrote and painted just as often with his left as with his right, and just as successfully.

This seems once more a hazardous statement to make about a remote ancestor, in the age before the great glacial epoch had furrowed the mountains of Northern Europe; but, nevertheless, it is strictly true and strictly demonstrable. Just try, as you read, to draw with the forefinger and thumb of your right hand an imaginary human profile on the page on which these words are printed. Do you observe that (unless you are an artist, and therefore sophisticated) you naturally and instinctively draw it with the face turned towards your left shoulder? Try now to draw it with the profile to the right, and you will find it requires a far greater effort of the thumb and fingers. The hand moves of its own accord from without inward, not from within outward. Then, again, draw with your left thumb and forefinger another imaginary profile, and you will find, for the same reason, that the face in this case looks rightward. Existing savages, and our own young children, whenever they draw a figure in profile, be it of man or beast, with their right hand, draw it almost always with the face or head turned to the left, in accordance with this natural human instinct. Their doing so is a test of their perfect right-handedness.

But Primitive Man, or at any rate the most primitive men we know personally, the carvers of the figures from the French bone-caves, drew men and beasts, on bone or mammoth-tusk, turned either way indiscriminately. The inference is obvious. They must have been ambidextrous. Only ambidextrous people draw so at the present day; and indeed to scrape a figure otherwise with a sharp flint on a piece of bone or tooth or mammoth-tusk would, even for a practised hand, be comparatively difficult.

I have begun my consideration of rights and lefts with this one very clear historical datum, because it is interesting to be able to say with tolerable certainty that there really was a period in our life as a species when man in the lump was ambidextrous. Why and how did he become otherwise? This question is not only of importance in itself, as helping to explain the origin and source of man's supremacy in nature—his tool-using faculty—but it is also of interest from the light it casts on that fallacy of poor Charles Reade's already alluded to—that we ought all of us in this respect to hark back to the condition of savages. I think when we have seen the reasons which make civilised man now right-handed, we shall also see why it would be highly undesirable for him to return, after so many ages of practice, to the condition of his undeveloped stone-age ancestors.

The very beginning of our modern right-handedness goes back, indeed, to the most primitive savagery. Why did one hand ever come to be different in use and function from another? The answer is, because man, in spite of all appearances to the contrary, is really one-sided. Externally, indeed, his congenital one-sidedness doesn't show: but it shows internally. We all of us know, in spite of Sganarelle's assertion to the contrary, that the apex of the heart inclines to the left side, and that the liver and other internal organs show a generous disregard for strict and formal symmetry. In this irregular distribution of those human organs which polite society agrees to ignore, we get the clue to the irregularity of right and left in the human arm, and finally even the particular direction of the printed letters now before you.

For primitive man did not belong to polite society. His manners were strikingly deficient in that repose which stamps the caste of Vere de Vere. When primitive man felt the tender passion steal over his soul, he lay in wait in the hush for the Phyllis or Daphne whose charms had inspired his heart with young desire; and when she passed his hiding-place, in maiden meditation, fancy free, he felled her with a club, caught her tight by the hair of her head, and dragged her off in triumph to his cave or his rock-shelter. (Marriage by capture, the learned call this simple mode of primeval courtship.) When he found some Strephon or Damœtas rival him in the affections of the dusky sex, he and that rival fought the matter out like two bulls in a field; and the victor and his Phyllis supped that evening off the roasted remains of the vanquished suitor. I don't say these habits and manners were pretty; but they were the custom of the time, and there's no good denying them.

Now, Primitive Man, being thus by nature a fighting animal, fought for the most part at first with his great canine teeth, his nails, and his fists; till in process of time he added to these early and natural weapons the further persuasions of a club or shillelagh. He also fought, as Darwin has very conclusively shown, in the main for the possession of the ladies of his kind, against other members of his own sex and species. And if you fight, you soon learn to protect the most exposed and vulnerable portion of your body; or, if you don't, natural selection manages it for you, by killing you off as an immediate consequence. To the boxer, wrestler, or hand-to-hand combatant, that most vulnerable portion is undoubtedly the heart. A hard blow, well delivered on the left breast, will easily kill, or at any rate stun, even a very strong man. Hence, from a very early period, men have used the right hand to fight with, and have employed the left arm chiefly to cover the heart and to parry a blow aimed at that specially vulnerable region. And when weapons of offence and defence supersede mere fists and teeth, it is the right hand that grasps the spear or sword, while the left holds over the heart for defence the shield or buckler.

From this simple origin, then, the whole vast difference of right and left in civilised life takes its beginning. At first, no doubt, the superiority of the right hand was only felt in the matter of fighting. But that alone gave it a distinct pull, and paved the way, at last, for its supremacy elsewhere. For when weapons came into use, the habitual employment of the right hand to grasp the spear, sword, or knife made the nerves and muscles of the right side far more obedient to the control of the will than those of the left. The dexterity thus acquired by the right—see how the very word 'dexterity' implies this fact—made it more natural for the early hunter and artificer to employ the same hand preferentially in the manufacture of flint hatchets, bows and arrows, and in all the other manifold

activities of savage life. It was the hand with which he grasped his weapon; it was therefore the hand with which he chipped it. To the very end, however, the right hand remains especially 'the hand in which you hold your knife;' and that is exactly how our own children to this day decide the question which is which, when they begin to know their right hand from their left for practical purposes.

A difference like this, once set up, implies thereafter innumerable other differences which naturally flow from it. Some of them are extremely remote and derivative. Take, for example, the case of writing and printing. Why do these run from left to right? At first sight such a practice seems clearly contrary to the instinctive tendency I noticed above—the tendency to draw from right to left, in accordance with the natural sweep of the hand and arm. And, indeed, it is a fact that all early writing habitually took the opposite direction from that which is now universal in western countries. Every schoolboy knows, for instance (or at least he would if he came up to the proper Macaulay standard), that Hebrew is written from right to left, and that each book begins at the wrong cover. The reason is that words, and letters, and hieroglyphics were originally carved, scratched, or incised, instead of being written with coloured ink, and the hand was thus allowed to follow its natural bent, and to proceed, as we all do in naïve drawing, with a free curve from the right leftward.

Nevertheless, the very same fact—that we use the right hand alone in writing—made the letters run the opposite way in the end; and the change was due to the use of ink and other pigments for staining papyrus, parchment, or paper. If the hand in this case moved from right to left it would of course smear what it had already written; and to prevent such untidy smudging of the words, the order of writing was reversed from left rightward. The use of wax tablets also, no doubt, helped forward the revolution, for in this case, too, the hand would cover and rub out the words written.

The strict dependence of writing, indeed, upon the material employed is nowhere better shown than in the case of the Assyrian cuneiform inscriptions. The ordinary substitute for cream-laid note in the Euphrates valley in its palmy days was a clay or terra-cotta tablet, on which the words to be recorded—usually a deed of sale or something of the sort—were impressed while it was wet and then baked in, solid. And the method of impressing them was very simple; the workman merely pressed the end of his graver or wedge into the moist clay, thus giving rise to triangular marks which were arranged in the shapes of various letters. When alabaster, or any other hard material, was substituted for clay, the sculptor imitated these natural dabs or triangular imprints; and that was the origin of those mysterious and very learned-looking cuneiforms. This, I admit, is a palpable digression; but inasmuch as it throws an indirect light on the simple reasons which sometimes bring about great results, I hold it not wholly alien to the present serious philosophical inquiry.

Printing, in turn, necessarily follows the rule of writing, so that in fact the order of letters and words on this page depends ultimately upon the remote fact that primitive man had to use his right hand to deliver a blow, and his left to parry, or to guard his heart.

Some curious and hardly noticeable results flow once more from this order of writing from left to right. You will find, if you watch yourself closely, that in examining a landscape, or the view from a hill-top, your eye naturally ranges from left to right; and that you begin your survey, as you would begin reading a page of print, from the left-hand corner. Apparently, the now almost instinctive act of reading (for Dogberry was right after all, for the civilised infant) has accustomed our eyes to this particular movement, and has made it especially natural when we are trying to 'read' or take in at a glance the meaning of any complex and varied total.

In the matter of pictures, I notice, the correlation has even gone a step farther. Not only do we usually take in the episodes of a painting from left to right, but the painter definitely and deliberately intends us so to take them in. For wherever two or three distinct episodes in succession are represented on a single plane in the same picture—as happens often in early art—they are invariably represented in the precise order of the words on a written or printed page, beginning at the upper left-hand corner, and ending at the lower right-hand angle. I first noticed this curious extension of the common principle in the mediæval frescoes of the Campo Santo at Pisa; and I have since verified it by observations

on many other pictures elsewhere, both ancient and modern. The Campo Santo, however, forms an exceptionally good museum of such story-telling frescoes by various painters, as almost every picture consists of several successive episodes. The famous Benozzo Gozzoli, for example, of Noah's Vineyard represents on a single plane all the stages in that earliest drama of intoxication, from the first act of gathering the grapes on the top left, to the scandalised lady, the *vergognosa di Pisa*, who covers her face with her hands in shocked horror at the patriarch's disgrace in the lower right-hand corner.

Observe, too, that the very conditions of *technique* demand this order almost as rigorously in painting as in writing. For the painter will naturally so work as not to smudge over what he has already painted: and he will also naturally begin with the earliest episode in the story he unfolds, proceeding to the others in due succession. From which two principles it necessarily results that he will begin at the upper left, and end at the lower right-hand corner.

I have skipped lightly, I admit, over a considerable interval between primitive man and Benozzo Gozzoli. But consider further that during all that time the uses of the right and left hand were becoming by gradual degrees each day still further differentiated and specialised. Innumerable trades, occupations, and habits imply ever-widening differences in the way we use them. It is not the right hand alone that has undergone an education in this respect: the left, too, though subordinate, has still its own special functions to perform. If the savage chips his flints with a blow of the right, he holds the core, or main mass of stone from which he strikes it, firmly with his left. If one hand is specially devoted to the knife, the other grasps the fork to make up for it. In almost every act we do with both hands, each has a separate office to which it is best fitted. Take, for example, so simple a matter as buttoning one's coat, where a curious distinction between the habits of the sexes enables us to test the principle with ease and certainty. Men's clothes are always made with the buttons on the right side and the button-holes on the left. Women's, on the contrary, are always made with the buttons on the left side, and the button-holes on the right. (The occult reason for this curious distinction, which has long engaged the attention of philosophers, has never yet been discovered, but it is probably to be accounted for by the perversity of women.) Well, if a man tries to put on a woman's waterproof, or a woman to put on a man's ulster, each will find that neither hand is readily able to perform the part of the other. A man, in buttoning, grasps the button in his right hand, pushes it through with his right thumb, holds the button-hole open with his left, and pulls all straight with his right fore-finger. Reverse the sides, and both hands at once seem equally helpless.

It is curious to note how many little peculiarities of dress or manufacture are equally necessitated by this prime distinction of right and left. Here are a very few of them, which the reader can indefinitely increase for himself. (I leave out of consideration obvious cases like boots and gloves: to insult that proverbially intelligent person's intelligence with those were surely unpardonable.) A scarf habitually tied in a sailor's knot acquires one long side, left, and one short one, right, from the way it is manipulated by the right hand; if it were tied by the left, the relations would be reversed. The spiral of corkscrews and of ordinary screws turned by hand goes in accordance with the natural twist of the right hand: try to drive in an imaginary corkscrew with the right hand, the opposite way, and you will see how utterly awkward and clumsy is the motion. The strap of the flap that covers the keyhole in trunks and portmanteaus always has its fixed side over to the right, and its buckle to the left; in this way only can it be conveniently buckled by a right-handed person. The hands of watches and the numbers of dial-faced barometers run from left to right: this is a peculiarity dependent upon the left to right system of writing. A servant offers you dishes from the left side: you can't so readily help yourself from the right, unless left-handed. Schopenhauer despaired of the German race, because it could never be taught like the English to keep to the right side of the pavement in walking. A sword is worn at the left hip: a handkerchief is carried in the right pocket, if at the side; in the left, if in the coat-tails: in either case for the right hand to get at it most easily. A watch-pocket is made in the left breast; a pocket for railway tickets halfway down the right side. Try to reverse any one of

these simple actions, and you will see at once that they are immediately implied in the very fact of our original right-handedness.

And herein, I think, we find the true answer to Charles Reade's mistaken notion of the advantages of ambidexterity. You couldn't make both hands do everything alike without a considerable loss of time, effort, efficiency, and convenience. Each hand learns to do its own work and to do it well; if you made it do the other hand's into the bargain, it would have a great deal more to learn, and we should find it difficult even then to prevent specialisation. We should have to make things deliberately different for the two hands—to have rights and lefts in everything, as we have them now in boots and gloves—or else one hand must inevitably gain the supremacy. Sword-handles, shears, surgical instruments, and hundreds of other things have to be made right-handed, while palettes and a few like subsidiary objects are adapted to the left; in each case for a perfectly sufficient reason. You can't upset all this without causing confusion. More than that, the division of labour thus brought about is certainly a gain to those who possess it: for if it were not so, the ambidextrous races would have beaten the dextro-sinistrals in the struggle for existence; whereas we know that the exact opposite has been the case. Man's special use of the right hand is one of his points of superiority to the brutes. If ever his right hand should forget its cunning, his supremacy would indeed begin to totter. Depend upon it, Nature is wiser than even Charles Reade. What she finds most useful in the long run must certainly have many good points to recommend it.

And this last consideration suggests another aspect of right and left which must not be passed over without one word in this brief survey of the philosophy of the subject. The superiority of the right caused it early to be regarded as the fortunate, lucky, and trusty hand; the inferiority of the left caused it equally to be considered as ill-omened, unlucky, and, in one expressive word, sinister. Hence come innumerable phrases and superstitions. It is the right hand of friendship that we always grasp; it is with our own right hand that we vindicate our honour against sinister suspicions. On the other hand, it is 'over the left' that we believe a doubtful or incredible statement; a left-handed compliment or a left-handed marriage carry their own condemnation with them. On the right hand of the host is the seat of honour; it is to the left that the goats of ecclesiastical controversy are invariably relegated. The very notions of the right hand and ethical right have got mixed up inextricably in every language: *droit* and *la droite* display it in French as much as right and the right in English. But to be *gauche* is merely to be awkward and clumsy; while to be right is something far higher and more important.

So unlucky, indeed, does the left hand at last become that merely to mention it is an evil omen; and so the Greeks refused to use the true old Greek word for left at all, and preferred euphemistically to describe it as *euonymos*, the well-named or happy-omened. Our own *left* seems equally to mean the hand that is left after the right has been mentioned, or, in short, the other one. Many things which are lucky if seen on the right are fateful omens if seen to leftward. On the other hand, if you spill the salt, you propitiate destiny by tossing a pinch of it over the left shoulder. A murderer's left hand is said by good authorities to be an excellent thing to do magic with; but here I cannot speak from personal experience. Nor do I know why the wedding-ring is worn on the left hand; though it is significant, at any rate, that the mark of slavery should be put by the man with his own right upon the inferior member of the weaker vessel. Strong-minded ladies may get up an agitation if they like to alter this gross injustice of the centuries.

One curious minor application of rights and lefts is the rule of the road as it exists in England. How it arose I can't say, any more than I can say why a lady sits her side-saddle to the left. Coachmen, to be sure, are quite unanimous that the leftward route enables them to see how close they are passing to another carriage; but, as all continental authority is equally convinced the other way, I make no doubt this is a mere illusion of long-continued custom. It is curious, however, that the English usage, having once obtained in these islands, has influenced railways, not only in Britain, but over all Europe. Trains, like carriages, go to the left when they pass; and this habit, quite natural in England, was transplanted by the early engineers to the Continent, where ordinary carriages, of course, go to the

right. In America, to be sure, the trains also go right like the carriages; but then, those Americans have such a curiously un-English way of being strictly consistent and logical in their doings. In Britain we should have compromised the matter by going sometimes one way and sometimes the other.

EVOLUTION

Everybody nowadays talks about evolution. Like electricity, the cholera germ, woman's rights, the great mining boom, and the Eastern Question, it is 'in the air.' It pervades society everywhere with its subtle essence; it infects small-talk with its familiar catchwords and its slang phrases; it even permeates that last stronghold of rampant Philistinism, the third leader in the penny papers. Everybody believes he knows all about it, and discusses it as glibly in his everyday conversation as he discusses the points of racehorses he has never seen, the charms of peeresses he has never spoken to, and the demerits of authors he has never read. Everybody is aware, in a dim and nebulous semi-conscious fashion, that it was all invented by the late Mr. Darwin, and reduced to a system by Mr. Herbert Spencer—don't you know?—and a lot more of those scientific fellows. It is generally understood in the best-informed circles that evolutionism consists for the most part in a belief about nature at large essentially similar to that applied by Topsy to her own origin and early history. It is conceived, in short, that most things 'growed.' Especially is it known that in the opinion of the evolutionists as a body we are all of us ultimately descended from men with tails, who were the final offspring and improved edition of the common gorilla. That, very briefly put, is the popular conception of the various points in the great modern evolutionary programme.

It is scarcely necessary to inform the intelligent reader, who of course differs fundamentally from that inferior class of human beings known to all of us in our own minds as 'other people,' that almost every point in the catalogue thus briefly enumerated is a popular fallacy of the wildest description. Mr. Darwin did not invent evolution any more than George Stephenson invented the steam-engine, or Mr. Edison the electric telegraph. We are not descended from men with tails, any more than we are descended from Indian elephants. There is no evidence that we have anything in particular more than the remotest fiftieth cousinship with our poor relation the West African gorilla. Science is not in search of a 'missing link'; few links are anywhere missing, and those are for the most part wholly unimportant ones. If we found the imaginary link in question, he would not be a monkey, nor yet in any way a tailed man. And so forth generally through the whole list of popular beliefs and current fallacies as to the real meaning of evolutionary teaching. Whatever most people think evolutionary is for the most part a pure parody of the evolutionist's opinion.

But a more serious error than all these pervades what we may call the drawing-room view of the evolutionist theory. So far as Society with a big initial is concerned, evolutionism first began to be talked about, and therefore known (for Society does not read; it listens, or rather it overhears and catches fragmentary echoes) when Darwin published his 'Origin of Species.' That great book consisted simply of a theory as to the causes which led to the distinctions of kind between plants and animals. With evolution at large it had nothing to do; it took for granted the origin of sun, moon, and stars, planets and comets, the earth and all that in it is, the sea and the dry land, the mountains and the valleys, nay even life itself in the crude form, everything in fact, save the one point of the various types and species of living beings. Long before Darwin's book appeared evolution had been a recognised force in the moving world of science and philosophy. Kant and Laplace had worked out the development of suns and earths from white-hot star-clouds. Lyell had worked out the evolution of the earth's surface to its present highly complex geographical condition. Lamarck had worked out the descent of plants and animals from a common ancestor by slow modification. Herbert Spencer had worked out the growth of mind from its simplest beginnings to its highest outcome in human thought.

But Society, like Gallio, cared nothing for all these things. The evolutionary principles had never been put into a single big book, asked for at Mudie's, and permitted to lie on the drawing-room table side by side with the last new novel and the last fat volume of scandalous court memoirs. Therefore Society ignored them and knew them not; the word evolution scarcely entered at all as yet into its polite and refined dinner-table vocabulary. It recognised only the 'Darwinian theory,' 'natural

selection,' 'the missing link,' and the belief that men were merely monkeys who had lost their tails, presumably by sitting upon them. To the world at large that learned Mr. Darwin had invented and patented the entire business, including descent with modification, if such notions ever occurred at all to the world-at-large's speculative intelligence.

Now, evolutionism is really a thing of far deeper growth and older antecedents than this easy, superficial drawing-room view would lead us to imagine. It is a very ancient and respectable theory indeed, and it has an immense variety of minor developments. I am not going to push it back, in the fashionable modern scientific manner, to the vague and indefinite hints in our old friend Lucretius. The great original Roman poet—the only original poet in the Latin language—did indeed hit out for himself a very good rough working sketch of a sort of nebulous and shapeless evolutionism. It was bold, it was consistent, for its time it was wonderful. But Lucretius's philosophy, like all the philosophies of the older world, was a mere speculative idea, a fancy picture of the development of things, not dependent upon observation of facts at all, but wholly evolved, like the German thinker's camel, out of its author's own pregnant inner consciousness. The Roman poet would no doubt have built an excellent superstructure if he had only possessed a little straw to make his bricks of. As it was, however, scientific brick-making being still in its infancy, he could only construct in a day a shadowy Aladdin's palace of pure fanciful Epicurean phantasms, an imaginary world of imaginary atoms, fortuitously concurring out of void chaos into an orderly universe, as though by miracle. It is not thus that systems arise which regenerate the thought of humanity; he who would build for all time must make sure first of a solid foundation, and then use sound bricks in place of the airy nothings of metaphysical speculation.

It was in the last century that the evolutionary idea really began to take form and shape in the separate conceptions of Kant, Laplace, Lamarck, and Erasmus Darwin. These were the true founders of our modern evolutionism. Charles Darwin and Herbert Spencer were the Joshuas who led the chosen people into the land which more than one venturous Moses had already dimly descried afar off from the Pisgah top of the eighteenth century.

Kant and Laplace came first in time, as astronomy comes first in logical order. Stars and suns, and planets and satellites, necessarily precede in development plants and animals. You can have no cabbages without a world to grow them in. The science of the stars was therefore reduced to comparative system and order, while the sciences of life, and mind, and matter were still a hopeless and inextricable muddle. It was no wonder, then, that the evolution of the heavenly bodies should have been clearly apprehended and definitely formulated while the evolution of the earth's crust was still imperfectly understood, and the evolution of living beings was only tentatively and hypothetically hinted at in a timid whisper.

In the beginning, say the astronomical evolutionists, not only this world, but all the other worlds in the universe, existed potentially, as the poet justly remarks, in 'a haze of fluid light,' a vast nebula of enormous extent and almost inconceivable material thinness. The world arose out of a sort of primitive world-gruel. The matter of which it was composed was gas, of such an extraordinary and unimaginable gasiness that millions of cubic miles of it might easily be compressed into a common antibilious pill-box. The pill-box itself, in fact, is the net result of a prolonged secular condensation of myriads of such enormous cubes of this primæval matter. Slowly setting around common centres, however, in anticipation of Sir Isaac Newton's gravitative theories, the fluid haze gradually collected into suns and stars, whose light and heat is presumably due to the clashing together of their component atoms as they fall perpetually towards the central mass. Just as in a burning candle the impact of the oxygen atoms in the air against the carbon and hydrogen atoms in the melted and rarefied wax or tallow produces the light and heat of the flame, so in nebula or sun the impact of the various gravitating atoms one against the other produces the light and heat by whose aid we are enabled to see and know those distant bodies. The universe, according to this now fashionable nebular theory, began as a single vast ocean of matter of immense tenuity, spread all alike over all space as far as

nowhere, and comparatively little different within itself when looked at side by side with its own final historical outcome. In Mr. Spencer's perspicuous phrase, evolution in this aspect is a change from the homogeneous to the heterogeneous, from the incoherent to the coherent, and from the indefinite to the definite condition. Difficult words at first to apprehend, no doubt, and therefore to many people, as to Mr. Matthew Arnold, very repellent, but full of meaning, lucidity, and suggestiveness, if only we once take the trouble fairly and squarely to understand them.

Every sun and every star thus formed is for ever gathering in the hem of its outer robe upon itself, for ever radiating off its light and heat into surrounding space, and for ever growing denser and colder as it sets slowly towards its centre of gravity. Our own sun and solar system may be taken as good typical working examples of how the stars thus constantly shrink into smaller and ever smaller dimensions around their own fixed centre. Naturally, we know more about our own solar system than about any other in our own universe, and it also possesses for us a greater practical and personal interest than any outside portion of the galaxy. Nobody can pretend to be profoundly immersed in the internal affairs of Sirius or of Alpha Centauri. A fiery revolution in the belt of Orion would affect us less than a passing finger-ache in a certain single terrestrial baby of our own household. Therefore I shall not apologise in any way for leaving the remainder of the sidereal universe to its unknown fate, and concentrating my attention mainly on the affairs of that solitary little, out-of-the-way, second-rate system, whereof we form an inappreciable portion. The matter which now composes the sun and its attendant bodies (the satellites included) was once spread out, according to Laplace, to at least the furthest orbit of the outermost planet—that is to say, so far as our present knowledge goes, the planet Neptune. Of course, when it was expanded to that immense distance, it must have been very thin indeed, thinner than our clumsy human senses can even conceive of. An American would say, too thin; but I put Americans out of court at once as mere irreverent scoffers. From the orbit of Neptune, or something outside it, the faint and cloud-like mass which bore within it Cæsar and his fortunes, not to mention the remainder of the earth and the solar system, began slowly to converge and gather itself in, growing denser and denser but smaller and smaller as it gradually neared its existing dimensions. How long a time it took to do it is for our present purpose relatively unimportant: the cruel physicists will only let us have a beggarly hundred million years or so for the process, while the grasping and extravagant evolutionary geologists beg with tears for at least double or even ten times that limited period. But at any rate it has taken a good long while, and, as far as most of us are personally concerned, the difference of one or two hundred millions, if it comes to that, is not really at all an appreciable one.

As it condensed and lessened towards its central core, revolving rapidly on its great axis, the solar mist left behind at irregular intervals concentric rings or belts of cloud-like matter, cast off from its equator; which belts, once more undergoing a similar evolution on their own account, have hardened round their private centres of gravity into Jupiter or Saturn, the Earth or Venus. Round these again, minor belts or rings have sometimes formed, as in Saturn's girdle of petty satellites; or subsidiary planets, thrown out into space, have circled round their own primaries, as the moon does around this sublunary world of ours. Meanwhile, the main central mass of all, retreating ever inward as it dropped behind it these occasional little reminders of its temporary stoppages, formed at last the sun itself, the main luminary of our entire system. Now, I won't deny that this primitive Kantian and Laplacian evolutionism, this nebular theory of such exquisite concinnity, here reduced to its simplest terms and most elementary dimensions, has received many hard knocks from later astronomers, and has been a good deal bowled over, both on mathematical and astronomical grounds, by recent investigators of nebulæ and meteors. Observations on comets and on the sun's surface have lately shown that it contains in all likelihood a very considerable fanciful admixture. It isn't more than half true; and even the half now totters in places. Still, as a vehicle of popular exposition the crude nebular hypothesis in its rawest form serves a great deal better than the truth, so far as yet known, on the good old Greek principle of the half being often more than the whole. The great point which it

impresses on the mind is the cardinal idea of the sun and planets, with their attendant satellites, not as turned out like manufactured articles, ready made, at measured intervals, in a vast and deliberate celestial Orrery, but as due to the slow and gradual working of natural laws, in accordance with which each has assumed by force of circumstances its existing place, weight, orbit, and motion.

The grand conception of a gradual becoming, instead of a sudden making, which Kant and Laplace thus applied to the component bodies of the universe at large, was further applied by Lyell and his school to the outer crust of this one particular petty planet of ours. While the astronomers went in for the evolution of suns, stars, and worlds, Lyell and his geological brethren went in for the evolution of the earth's surface. As theirs was stellar, so his was mundane. If the world began by being a red-hot mass of planetary matter in a high state of internal excitement, boiling and dancing with the heat of its emotions, it gradually cooled down with age and experience, for growing old is growing cold, as every one of us in time, alas, discovers. As it passed from its fiery and volcanic youth to its staider and soberer middle age, a solid crust began to form in filmy fashion upon its cooling surface. The aqueous vapour that had floated at first as steam around its heated mass condensed with time into a wide ocean over the now hardened shell. Gradually this ocean shifted its bulk into two or three main bodies that sank into hollows of the viscid crust, the precursors of Atlantic, Pacific, and the Indian Seas. Wrinklings of the crust, produced by the cooling and consequent contraction, gave rise at first to baby mountain ranges, and afterwards to the earliest rough draughts of the still very vague and sketchy continents. The world grew daily more complex and more diverse; it progressed, in accordance with the Spencerian law, from the homogeneous to the heterogeneous, and so forth, as aforesaid, with delightful regularity.

At last, by long and graduated changes, seas and lands, peninsulas and islands, lakes and rivers, hills and mountains, were wrought out by internal or external energies on the crust thus generally fashioned. Evaporation from the oceans gave rise to clouds and rain and hailstorms; the water that fell upon the mountain tops cut out the valleys and river basins; rills gathered into brooks, brooks into streams, streams into primæval Niles, and Amazons, and Mississippis. Volcanic forces uplifted here an Alpine chain, or depressed there a deep-sea hollow. Sediment washed from the hills and plains, or formed from countless skeletons of marine creatures, gathered on the sinking bed of the ocean as soft ooze, or crumbling sand, or thick mud, or gravel and conglomerate. Now upheaved into an elevated table-land, now slowly carved again by rain and rill into valley and watershed, and now worn down once more into the mere degraded stump of a plateau, the crust underwent innumerable changes, but almost all of them exactly the same in kind, and mostly in degree, as those we still see at work imperceptibly in the world around us. Rain washing down the soil; weather crumbling the solid rock; waves dashing at the foot of the cliffs; rivers forming deltas at their barred mouths; shingle gathering on the low spits; floods sweeping before them the countryside; ice grinding ceaselessly at the mountain top; peat filling up the shallow lake—these are the chief factors which have gone to make the physical world as we now actually know it. Land and sea, coast and contour, hill and valley, dale and gorge, earth-sculpture generally—all are due to the ceaseless interaction of these separately small and unnoticeable causes, aided or retarded by the slow effects of elevation or depression from the earth's shrinkage towards its own centre. Geology, in short, has shown us that the world is what it is, not by virtue of a single sudden creative act, nor by virtue of successive terrible and recurrent cataclysms, but by virtue of the slow continuous action of causes still always equally operative.

Evolution in geology leads up naturally to evolution in the science of life. If the world itself grew, why not also the animals and plants that inhabit it? Already in the eager active eighteenth century this obvious idea had struck in the germ a large number of zoologists and botanists, and in the hands of Lamarck and Erasmus Darwin it took form as a distinct and elaborate system of organic evolution. Buffon had been the first to hint at the truth; but Buffon was an eminently respectable nobleman in the dubious days of the tottering monarchy, and he did not care personally for the Bastille, viewed as a place of permanent residence. In Louis Quinze's France, indeed, as things then went, a man who

offended the orthodoxy of the Sorbonne was prone to find himself shortly ensconced in free quarters, and kept there for the term of his natural existence without expense to his heirs or executors. So Buffon did not venture to say outright that he thought all animals and plants were descended one from the other with slight modifications; that would have been wicked, and the Sorbonne would have proved its wickedness to him in a most conclusive fashion by promptly getting him imprisoned or silenced. It is so easy to confute your opponent when you are a hundred strong and he is one weak unit. Buffon merely said, therefore, that if we didn't know the contrary to be the case by sure warrant, we might easily have concluded (so fallible is our reason) that animals always varied slightly, and that such variations, indefinitely accumulated, would suffice to account for almost any amount of ultimate difference. A donkey might thus have grown into a horse, and a bird might have developed from a primitive lizard. Only we know it was quite otherwise! A quiet hint from Buffon was as good as a declaration from many less knowing or suggestive people. All over Europe, the wise took Buffon's hint for what he meant it; and the unwise blandly passed it by as a mere passing little foolish vagary of that great ironical writer and thinker.

Erasmus Darwin, the grandfather of his grandson, was no fool; on the contrary, he was the most far-sighted man of his day in England; he saw at once what Buffon was driving at; and he worked out 'Mr. Buffon's' half-concealed hint to all its natural and legitimate conclusions. The great Count was always plain Mr. Buffon to his English contemporary. Life, said Erasmus Darwin nearly a century since, began in very minute marine forms, which gradually acquired fresh powers and larger bodies, so as imperceptibly to transform themselves into different creatures. Man, he remarked, anticipating his descendant, takes rabbits or pigeons, and alters them almost to his own fancy, by immensely changing their shapes and colours. If man can make a pouter or a fantail out of the common runt, if he can produce a piebald lop-ear from the brown wild rabbit, if he can transform Dorkings into Black Spanish, why cannot Nature, with longer time to work in, and endless lives to try with, produce all the varieties of vertebrate animals out of one single common ancestor? It was a bold idea of the Lichfield doctor—bold, at least, for the times he lived in—when Sam Johnson was held a mighty sage, and physical speculation was regarded askance as having in it a dangerous touch of the devil. But the Darwins were always a bold folk, and had the courage of their opinions more than most men. So even in Lichfield, cathedral city as it was, and in the politely somnolent eighteenth century, Erasmus Darwin ventured to point out the probability that quadrupeds, birds, reptiles, and men were all mere divergent descendants of a single similar original form, and even that 'one and the same kind of living filament is, and has been, the cause of organic life.'

The eighteenth century laughed, of course. It always laughed at all reformers. It said Dr. Darwin was very clever, but really a most eccentric man. His 'Temple of Nature,' now, and his 'Botanic Garden,' were vastly fine and charming poems—those sweet lines, you know, about poor Eliza!—but his zoological theories were built of course upon a most absurd and uncertain foundation. In prose, no sensible person could ever take the doctor seriously. A freak of genius—nothing more; a mere desire to seem clever and singular. But what a Nemesis the whirligig of time has brought around with it! By a strange irony of fate, those admired verses are now almost entirely forgotten; poor Eliza has survived only as our awful example of artificial pathos; and the zoological heresies, at which the eighteenth century shrugged its fat shoulders and dimpled the corners of its ample mouth, have grown to be the chief cornerstone of all accepted modern zoological science.

In the first year of the present century, Lamarck followed Erasmus Darwin's lead with an open avowal that in his belief all animals and plants were really descended from one or a few common ancestors. He held that organisms were just as much the result of law, not of miraculous interposition, as suns and worlds and all the natural phenomena around us generally. He saw that what naturalists call a species differs from what naturalists call a variety, merely in the way of being a little more distinctly marked, a little less like its nearest congeners elsewhere. He recognised the perfect gradation of forms by which in many cases one species after another merges into the next on either side of it. He observed

the analogy between the modifications induced by man and the modifications induced by nature. In fact, he was a thorough-going and convinced evolutionist, holding every salient opinion which Society still believes to have been due to the works of Charles Darwin. In one point only, a minor point to outsiders, though a point of cardinal importance to the inner brotherhood of evolutionism, he did not anticipate his more famous successor. He thought organic evolution was wholly due to the direct action of surrounding circumstances, to the intercrossing of existing forms, and above all to the actual efforts of animals themselves. In other words, he had not discovered natural selection, the cardinal idea of Charles Darwin's epoch-making book. For him, the giraffe had acquired its long neck by constant reaching up to the boughs of trees; the monkey had acquired its opposable thumb by constant grasping at the neighbouring branches; and the serpent had acquired its sinuous shape by constant wriggling through the grass of the meadows. Charles Darwin improved upon all that by his suggestive hint of survival of the fittest, and in so far, but in so far alone, he became the real father of modern biological evolutionism.

From the days of Lamarck, to the day when Charles Darwin himself published his wonderful 'Origin of Species,' this idea that plants and animals might really have grown, instead of having been made all of a piece, kept brewing everywhere in the minds and brains of scientific thinkers. The notions which to the outside public were startlingly new when Darwin's book took the world by storm, were old indeed to the thinkers and workers who had long been familiar with the principle of descent with modification and the speculations of the Lichfield doctor or the Paris philosopher. Long before Darwin wrote his great work, Herbert Spencer had put forth in plain language every idea which the drawing-room biologists attributed to Darwin. The supporters of the development hypothesis, he said seven years earlier—yes, he called it the 'development hypothesis' in so many words—'can show that modification has effected and is effecting great changes in all organisms, subject to modifying influences.' They can show, he goes on (if I may venture to condense so great a thinker), that any existing plant or animal, placed under new conditions, begins to undergo adaptive changes of form and structure; that in successive generations these changes continue, till the plant or animal acquires totally new habits; that in cultivated plants and domesticated animals changes of the sort habitually occur; that the differences thus caused, as for example in dogs, are often greater than those on which species in the wild state are founded, and that throughout all organic nature there *is* at work a modifying influence of the same sort as that which they believed to have caused the differences of species—'an influence which, to all appearance, would produce in the millions of years and under the great variety of conditions which geological records imply, any amount of change.' What is this but pure Darwinism, as the drawing-room philosopher still understands the word? And yet it was written seven years before Darwin published the 'Origin of Species.'

The fact is, one might draw up quite a long list of Darwinians before Darwin. Here are a few of them—Buffon, Lamarck, Goethe, Oken, Bates, Wallace, Lecoq, Von Baer, Robert Chambers, Matthew, and Herbert Spencer. Depend upon it, no one man ever yet of himself discovered anything. As well say that Luther made the German Reformation, that Lionardo made the Italian Renaissance, or that Robespierre made the French Revolution, as say that Charles Darwin, and Charles Darwin alone, made the evolutionary movement, even in the restricted field of life only. A thousand predecessors worked up towards him; a thousand contemporaries helped to diffuse and to confirm his various principles.

Charles Darwin added to the primitive evolutionary idea the special notion of natural selection. That is to say, he pointed out that while plants and animals vary perpetually and vary indefinitely, all the varieties so produced are not equally adapted to the circumstances of the species. If the variation is a bad one, it tends to die out, because every point of disadvantage tells against the individual in the struggle for life. If the variation is a good one, it tends to persist, because every point of advantage similarly tells in the individual's favour in that ceaseless and viewless battle. It was this addition to the evolutionary concept, fortified by Darwin's powerful advocacy of the general principle of descent

with modification, that won over the whole world to the 'Darwinian theory.' Before Darwin, many men of science were evolutionists: after Darwin, all men of science became so at once, and the rest of the world is rapidly preparing to follow their leadership.

As applied to life, then, the evolutionary idea is briefly this—that plants and animals have all a natural origin from a single primitive living creature, which itself was the product of light and heat acting on the special chemical constituents of an ancient ocean. Starting from that single early form, they have gone on developing ever since, from the homogeneous to the heterogeneous, assuming ever more varied shapes, till at last they have reached their present enormous variety of tree, and shrub, and herb, and seaweed, of beast, and bird, and fish, and creeping insect. Evolution throughout has been one and continuous, from nebula to sun, from gas-cloud to planet, from early jelly-speck to man or elephant. So at least evolutionists say—and of course they ought to know most about it.

But evolution, according to the evolutionists, does not even stop here. Psychology as well as biology has also its evolutionary explanation: mind is concerned as truly as matter. If the bodies of animals are evolved, their minds must be evolved likewise. Herbert Spencer and his followers have been mainly instrumental in elucidating this aspect of the case. They have shown, or they have tried to show (for I don't want to dogmatise on the subject), how mind is gradually built up from the simplest raw elements of sense and feeling; how emotions and intellect slowly arise; how the action of the environment on the organism begets a nervous system of ever greater and greater complexity, culminating at last in the brain of a Newton, a Shakespeare, or a Mendelssohn. Step by step, nerves have built themselves up out of the soft tissues as channels of communication between part and part. Sense-organs of extreme simplicity have first been formed on the outside of the body, where it comes most into contact with external nature. Use and wont have fashioned them through long ages into organs of taste and smell and touch; pigment spots, sensitive to light or shade, have grown by infinite gradations into the human eye or into the myriad facets of bee and beetle; tremulous nerve-ends, responsive sympathetically to waves of sound, have tuned themselves at last into a perfect gamut in the developed ear of men and mammals. Meanwhile corresponding percipient centres have grown up in the brain, so that the coloured picture flashed by an external scene upon the eye is telegraphed from the sensitive mirror of the retina, through the many-stranded cable of the optic nerve, straight up to the appropriate headquarters in the thinking brain. Stage by stage the continuous process has gone on unceasingly, from the jelly-fish with its tiny black specks of eyes, through infinite steps of progression, induced by ever-widening intercourse with the outer world, to the final outcome in the senses and the emotions, the intellect and the will, of civilised man. Mind begins as a vague consciousness of touch or pressure on the part of some primitive, shapeless, soft creature: it ends as an organised and co-ordinated reflection of the entire physical and psychical universe on the part of a great cosmical philosopher.

Last of all, like diners-out at dessert, the evolutionists take to politics. Having shown us entirely to their own satisfaction the growth of suns, and systems, and worlds, and continents, and oceans, and plants, and animals, and minds, they proceed to show us the exactly analogous and parallel growth of communities, and nations, and languages, and religions, and customs, and arts, and institutions, and literatures. Man, the evolving savage, as Tylor, Lubbock, and others have proved for us, slowly putting off his brute aspect derived from his early ape-like ancestors, learned by infinitesimal degrees the use of fire, the mode of manufacturing stone hatchets and flint arrowheads, the earliest beginnings of the art of pottery. With drill or flint he became the Prometheus to his own small heap of sticks and dry leaves among the tertiary forests. By his nightly camp-fire he beat out gradually his excited gesture-language and his oral speech. He tamed the dog, the horse, the cow, the camel. He taught himself to hew small clearings in the woodland, and to plant the banana, the yam, the bread-fruit, and the cocoa-nut. He picked and improved the seeds of his wild cereals till he made himself from grass-like grains his barley, his oats, his wheat, his Indian corn. In time, he dug out ore from mines, and learnt the use first of gold, next of silver, then of copper, tin, bronze, and iron. Side by side with these long secular

changes, he evolved the family, communal or patriarchal, polygamic or monogamous. He built the hut, the house, and the palace. He clothed or adorned himself first in skins and leaves and feathers; next in woven wool and fibre; last of all in purple and fine linen, and fared sumptuously every day. He gathered into hordes, tribes, and nations; he chose himself a king, gave himself laws, and built up great empires in Egypt, Assyria, China, and Peru. He raised him altars, Stonehenges and Karnaks. His picture-writing grew into hieroglyphs and cuneiforms, and finally emerged, by imperceptible steps, into alphabetic symbols, the raw material of the art of printing. His dug-out canoe culminates in the iron-clad and the 'Great Eastern'; his boomerang and slingstone in the Woolwich infant; his boiling pipkin and his wheeled car in the locomotive engine; his picture-message in the telephone and the Atlantic cable. Here, where the course of evolution has really been most marvellous, its steps have been all more distinctly historical; so that nobody now doubts the true descent of Italian, French, and Spanish from provincial Latin, or the successive growth of the trireme, the 'Great Harry,' the 'Victory,' and the 'Minotaur' from the coracles or praus of prehistoric antiquity.

The grand conception of the uniform origin and development of all things, earthly or sidereal, thus summed up for us in the one word evolution, belongs by right neither to Charles Darwin nor to any other single thinker. It is the joint product of innumerable workers, all working up, though some of them unconsciously, towards a grand final unified philosophy of the cosmos. In astronomy, Kant, Laplace, and the Herschels; in geology, Hutton, Lyell, and the Geikies; in biology, Buffon, Lamarck, the Darwins, Huxley, and Spencer; in psychology, Spencer, Romanes, Sully, and Ribot; in sociology, Spencer, Tylor, Lubbock, and De Mortillet—these have been the chief evolutionary teachers and discoverers. But the use of the word evolution itself, and the establishment of the general evolutionary theory as a system of philosophy applicable to the entire universe, we owe to one man alone—Herbert Spencer. Many other minds—from Galileo and Copernicus, from Kepler and Newton, from Linnæus and Tournefort, from D'Alembert and Diderot, nay, even, in a sense, from Aristotle and Lucretius—had been piling together the vast collection of raw material from which that great and stately superstructure was to be finally edified. But the architect who placed each block in its proper niche, who planned and designed the whole elevation, who planted the building firmly on the rock and poised the coping-stone on the topmost pinnacle, was the author of the 'System of Synthetic Philosophy,' and none other. It is a strange proof of how little people know about their own ideas, that among the thousands who talk glibly every day of evolution, not ten per cent. are probably aware that both word and conception are alike due to the commanding intelligence and vast generalising power of Herbert Spencer.

STRICTLY INCOG

Among the reefs of rock upon the Australian coast, an explorer's dredge often brings up to the surface some tangled tresses of reddish seaweed, which, when placed for a while in a bucket of water, begin slowly to uncoil themselves as if endowed with animal life, and finally to swim about with a gentle tremulous motion in a mute inquiring way from side to side of the pail that contains them. Looked at closely with an attentive eye, the complex moving mass gradually resolves itself into two parts: one a ruddy seaweed with long streaming fronds; the other, a strangely misshapen and dishevelled pipe-fish, exactly imitating the weed itself in form and colour. When removed from the water, this queer pipe-fish proves in general outline somewhat to resemble the well-known hippocampus or sea-horse of the aquariums, whose dried remains, in a mummified state, form a standing wonder in many tiny domestic museums. But the Australian species, instead of merely mimicking the knight on a chess-board, looks rather like a hippocampus in the most advanced stage of lunacy, with its tail and fins and the appendages of its spines flattened out into long thin streaming filaments, utterly indistinguishable in hue and shape from the fucus round which the creature clings for support with its prehensile tail. Only a rude and shapeless rough draught of a head, vaguely horse-like in contour, and inconspicuously provided with an unobtrusive snout and a pair of very unnoticeable eyes, at all suggests to the most microscopic observer its animal nature. Taken as a whole, nobody could at first sight distinguish it in any way from the waving weed among which it vegetates.

Clearly, this curious Australian cousin of the Mediterranean sea-horses has acquired so marvellous a resemblance to a bit of fucus in order to deceive the eyes of its ever-watchful enemies, and to become indistinguishable from the uneatable weed whose colour and form it so surprisingly imitates. Protective resemblances of the sort are extremely common among the pipe-fish family, and the reason why they should be so is no doubt sufficiently obvious at first sight to any reflecting mind —such, for example, as the intelligent reader's. Pipe-fish, as everybody knows, are far from giddy. They do not swim in the vortex of piscine dissipation. Being mostly small and defenceless creatures, lurking among the marine vegetation of the shoals and reefs, they are usually accustomed to cling for support by their snake-like tails to the stalks or leaves of those submerged forests. The omniscient schoolboy must often have watched in aquariums the habits and manners of the common sea-horses, twisted together by their long thin bodies into one inextricable mass of living matwork, or anchored firmly with a treble serpentine coil to some projecting branch of coralline or of quivering sea-wrack. Bad swimmers by nature, utterly unarmed, and wholly undefended by protective mail, the pipe-fish generally can neither fight nor run away: and therefore they depend entirely for their lives upon their peculiar skulking and lurking habits. Their one mode of defence is not to show themselves; discretion is the better part of their valour; they hide as much as possible among the thickest seaweed, and trust to Providence to escape observation.

Now, with any animals thus constituted, cowards by hereditary predilection, it must necessarily happen that the more brightly coloured or obtrusive individuals will most readily be spotted and most unceremoniously devoured by their sharp-sighted foes, the predatory fishes. On the other hand, just in proportion as any particular pipe-fish happens to display any chance resemblance in colour or appearance to the special seaweed in whose folds it lurks, to that extent will it be likely to escape detection, and to hand on its peculiarities to its future descendants. A long-continued course of the simple process thus roughly described must of necessity result at last in the elimination of all the most conspicuous pipe-fish, and the survival of all those unobtrusive and retiring individuals which in any respect happen to resemble the fucus or coralline among which they dwell. Hence, in many places, various kinds of pipe-fish exhibit an extraordinary amount of imitative likeness to the sargasso or seaweed to whose tags they cling; and in the three most highly developed Australian species the

likeness becomes so ridiculously close that it is with difficulty one can persuade oneself one is really and truly looking at a fish, and not at a piece of strangely animated and locomotive fucus.

Of course, the playful pipe-fish is by no means alone in his assumption of so neat and effective a disguise. Protective resemblances of just the same sort as that thus exhibited by this extraordinary little creature are common throughout the whole range of nature; instances are to be found in abundance, not only among beasts, birds, reptiles, and fishes, but even among caterpillars, butterflies, and spiders, of species which preserve the strictest incognito. Everywhere in the world, animals and plants are perpetually masquerading in various assumed characters; and sometimes their make-up is so exceedingly good as to take in for a while not merely the uninstructed ordinary observer, but even the scientific and systematic naturalist.

A few selected instances of such successful masquerading will perhaps best serve to introduce the general principles upon which all animal mimicry ultimately depends. Indeed, naturalists of late years have been largely employed in fishing up examples from the ends of the earth and from the depths of the sea for the elucidation of this very subject. There is a certain butterfly in the islands of the Malay Archipelago (its learned name, if anybody wishes to be formally introduced, is *Kallima paralekta*) which always rests among dead or dry leaves, and has itself leaf-like wings, all spotted over at intervals with wee speckles to imitate the tiny spots of fungi on the foliage it resembles. The well-known stick and leaf insects from the same rich neighbourhood in like manner exactly mimic the twigs and leaves of the forest among which they lurk: some of them look for all the world like little bits of walking bamboo, while others appear in all varieties of hue, as if opening buds and full-blown leaves and pieces of yellow foliage sprinkled with the tints and moulds of decay had of a sudden raised themselves erect upon six legs, and begun incontinently to perambulate the Malayan woodlands like vegetable Frankensteins in all their glory. The larva of one such deceptive insect, observed in Nicaragua by sharp-eyed Mr. Belt, appeared at first sight like a mere fragment of the moss on which it rested, its body being all prolonged into little thread-like green filaments, precisely imitating the foliage around it. Once more, there are common flies which secure protection for themselves by growing into the counterfeit presentment of wasps or hornets, and so obtaining immunity from the attacks of birds or animals. Many of these curiously mimetic insects are banded with yellow and black in the very image of their stinging originals, and have their tails sharpened, *in terrorem*, into a pretended sting, to give point and verisimilitude to the deceptive resemblance. More curious still, certain South American butterflies of a perfectly inoffensive and edible family mimic in every spot and line of colour sundry other butterflies of an utterly unrelated and fundamentally dissimilar type, but of so disagreeable a taste as never to be eaten by birds or lizards. The origin of these curious resemblances I shall endeavour to explain (after Messrs. Bates and Wallace) a little farther on: for the present it is enough to observe that the extraordinary resemblances thus produced have often deceived the very elect, and have caused experienced naturalists for a time to stick some deceptive specimen of a fly among the wasps and hornets, or some masquerading cricket into the midst of a cabinet full of saw-flies or ichneumons.

Let us look briefly at the other instances of protective coloration in nature generally which lead up to these final bizarre exemplifications of the masquerading tendency.

Wherever all the world around is remarkably uniform in colour and appearance, all the animals, birds, and insects alike necessarily disguise themselves in its prevailing tint to escape observation. It does not matter in the least whether they are predatory or defenceless, the hunters or the hunted: if they are to escape destruction or starvation, as the case may be, they must assume the hue of all the rest of nature about them. In the arctic snows, for example, all animals, without exception, must needs be snow-white. The polar bear, if he were brown or black, would immediately be observed among the unvaried ice-fields by his expected prey, and could never get a chance of approaching his quarry unperceived at close quarters. On the other hand, the arctic hare must equally be dressed in a snow-white coat, or the arctic fox would too readily discover him and pounce down upon him off-

hand; while, conversely, the fox himself, if red or brown, could never creep upon the unwary hare without previous detection, which would defeat his purpose. For this reason, the ptarmigan and the willow grouse become as white in winter as the vast snow-fields under which they burrow; the ermine changes his dusky summer coat for the expensive wintry suit beloved of British Themis; the snow-bunting acquires his milk-white plumage; and even the weasel assimilates himself more or less in hue to the unvarying garb of arctic nature. To be out of the fashion is there quite literally to be out of the world: no half-measures will suit the stern decree of polar biology; strict compliance with the law of winter change is absolutely necessary to success in the struggle for existence.

Now, how has this curious uniformity of dress in arctic animals been brought about? Why, simply by that unyielding principle of Nature which condemns the less adapted for ever to extinction, and exalts the better adapted to the high places of her hierarchy in their stead. The ptarmigan and the snow-buntings that look most like the snow have for ages been least likely to attract the unfavourable attention of arctic fox or prowling ermine; the fox or ermine that came most silently and most unperceived across the shifting drifts has been most likely to steal unawares upon the heedless flocks of ptarmigan and snow-bunting. In the one case protective colouring preserves the animal from himself being devoured; in the other case it enables him the more easily to devour others. And since 'Eat or be eaten' is the shrill sentence of Nature upon all animal life, the final result is the unbroken whiteness of the arctic fauna in all its developments of fur or feather.

Where the colouring of nature is absolutely uniform, as among the arctic snows or the chilly mountain tops, the colouring of the animals is uniform too. Where it is slightly diversified from point to point, as in the sands of the desert, the animals that imitate it are speckled or diversified with various soft neutral tints. All the birds, reptiles, and insects of Sahara, says Canon Tristram, copy closely the grey or isabelline colour of the boundless sands that stretch around them. Lord George Campbell, in his amusing 'Log Letters from the "Challenger,"' mentions a butterfly on the shore at Amboyna which looked exactly like a bit of the beach, until it spread its wings and fluttered away gaily to leeward. Soles and other flat-fish similarly resemble the sands or banks on which they lie, and accommodate themselves specifically to the particular colour of their special bottom. Thus the flounder imitates the muddy bars at the mouths of rivers, where he loves to half bury himself in the congenial ooze; the sole, who rather affects clean hard sand-banks, is simply sandy and speckled with grey; the plaice, who goes in by preference for a bed of mixed pebbles, has red and yellow spots scattered up and down irregularly among the brown, to look as much as possible like agates and carnelians: the brill, who hugs a still rougher ledge, has gone so far as to acquire raised lumps or tubercles on his upper surface, which make him seem like a mere bit of the shingle-strewn rock on which he reposes. In short, where the environment is most uniform the colouring follows suit: just in proportion as the environment varies from place to place, the colouring must vary in order to simulate it. There is a deep biological joy in the term 'environment'; it almost rivals the well-known consolatory properties of that sweet word 'Mesopotamia.' 'Surroundings,' perhaps, would equally well express the meaning, but then, as Mr. Wordsworth justly observes, 'the difference to me!'

Between England and the West Indies, about the time when one begins to recover from the first bout of sea-sickness, we come upon a certain sluggish tract of ocean, uninvaded by either Gulf Stream or arctic current, but slowly stagnating in a sort of endless eddy of its own, and known to sailors and books of physical geography as the Sargasso Sea. The sargasso or floating seaweed from which it takes its poetical name is a pretty yellow rootless alga, swimming in vast quantities on the surface of the water, and covered with tiny bladder-like bodies which at first sight might easily be mistaken for amber berries. If you drop a bucket over the ship's side and pull up a tangled mass of this beautiful seaweed, it will seem at first to be all plant alike; but, when you come to examine its tangles closely, you will find that it simply swarms with tiny crabs, fishes, and shrimps, all coloured so precisely to shade that they look exactly like the sargasso itself. Here the colour about is less uniform than in the arctic snows, but, so far as the sargasso-haunting animals are concerned, it comes pretty much to

the same thing. The floating mass of weed is their whole world, and they have had to accommodate themselves to its tawny hue under pain of death, immediate and violent.

Caterpillars and butterflies often show us a further step in advance in the direction of minute imitation of ordinary surroundings. Dr. Weismann has published a very long and learned memoir, fraught with the best German erudition and prolixity, upon this highly interesting and obscure subject. As English readers, however, not unnaturally object to trudging through a stout volume on the larva of the sphinx moth, conceived in the spirit of those patriarchal ages of Hilpa and Shalum, when man lived to nine hundred and ninety-nine years, and devoted a stray century or so without stint to the work of education, I shall not refer them to Dr. Weismann's original treatise, as well translated and still further enlarged by Mr. Raphael Meldola, but will present them instead with a brief *résumé*, boiled down and condensed into a patent royal elixir of learning. Your caterpillar, then, runs many serious risks in early life from the annoying persistence of sundry evil-disposed birds, who insist at inconvenient times in picking him off the leaves of gooseberry bushes and other his chosen places of residence. His infant mortality, indeed, is something simply appalling, and it is only by laying the eggs that produce him in enormous quantities that his fond mother the butterfly ever succeeds in rearing on an average two of her brood to replace the imago generation just departed. Accordingly, the caterpillar has been forced by adverse circumstances to assume the most ridiculous and impossible disguises, appearing now in the shape of a leaf or stem, now as a bundle of dark-green pine needles, and now again as a bud or flower, all for the innocent purpose of concealing his whereabouts from the inquisitive gaze of the birds his enemies.

When the caterpillar lives on a plant like a grass, the ribs or veins of which run up and down longitudinally, he is usually striped or streaked with darker lines in the same direction as those on his native foliage. When, on the contrary, he lives upon broader leaves, provided with a midrib and branching veins, his stripes and streaks (not to be out of the fashion) run transversely and obliquely, at exactly the same angle as those of his wonted food-plant. Very often, if you take a green caterpillar of this sort away from his natural surroundings, you will be surprised at the conspicuousness of his pale lilac or mauve markings; surely, you will think to yourself, such very distinct variegation as that must betray him instantly to his watchful enemies. But no; if you replace him gently where you first found him, you will see that the lines exactly harmonise with the joints and shading of his native leaf: they are delicate representations of the soft shadow cast by a rib or vein, and the local colour is precisely what a painter would have had to use in order to produce the corresponding effect. The shadow of yellowish green is, of course, always purplish or lilac. It may at first sight seem surprising that a caterpillar should possess so much artistic sense and dexterity; but then the penalty for bungling or inharmonious work is so very severe as necessarily to stimulate his imitative genius. Birds are for ever hunting him down among the green leaves, and only those caterpillars which effectually deceive them by their admirable imitations can ever hope to survive and become the butterflies who hand on their larval peculiarities to after ages. Need I add that the variations are, of course, unconscious, and that accident in the first place is ultimately answerable for each fresh step in the direction of still closer simulation?

The geometric moths have brown caterpillars, which generally stand erect when at rest on the branches of trees and so resemble small twigs; and, in order that the resemblance may be the more striking, they are often covered with tiny warts which look like buds or knots upon the surface. The larva of that familiar and much-dreaded insect, the death's-head hawk-moth, feeds as a rule on the foliage of the potato, and its very varied colouring, as Sir John Lubbock has pointed out, so beautifully harmonises with the brown of the earth, the yellow and green of the leaves, and the faint purplish blue of the lurid flowers, that it can only be distinguished when the eye happens accidentally to focus itself exactly upon the spot occupied by the unobtrusive caterpillar. Other larvæ which frequent pine trees have their bodies covered with tufts of green hairs that serve to imitate the peculiar pine foliage. One queer little caterpillar, which lives upon the hoary foliage of the sea-buckthorn, has a grey-green

body, just like the buckthorn leaves, relieved by a very conspicuous red spot which really represents in size and colour one of the berries that grow around it. Finally the larva of the elephant hawk-moth, which grows to a very large size, has a pair of huge spots that seem like great eyes; and direct experiment establishes the fact that small birds mistake it for a young snake, and stand in terrible awe of it accordingly, though it is in reality a perfectly harmless insect, and also, as I am credibly informed (for I cannot speak upon the point from personal experience), a very tasty and well-flavoured insect, and 'quite good to eat' too, says an eminent authority. One of these big snake-like caterpillars once frightened Mr. Bates himself on the banks of the Amazon.

Now, I know that cantankerous person, the universal objector, has all along been bursting to interrupt me and declare that he himself frequently finds no end of caterpillars, and has not the slightest difficulty at all in distinguishing them with the naked eye from the leaves and plants among which they are lurking. But observe how promptly we crush and demolish this very inconvenient and disconcerting critic. The caterpillars *he* finds are almost all hairy ones, very conspicuous and easy to discover—'woolly bears,' and such like common and unclean creatures—and the reason they take no pains to conceal themselves from his unobservant eyes is simply this: nobody on earth wants to discover them. For either they are protectively encased in horrid hairs, which get down your throat and choke you and bother you (I speak as a bird, from the point of view of a confirmed caterpillar eater), or else they are bitter and nasty to the taste, like the larva of the spurge moth and the machaon butterfly. These are the ordinary brown and red and banded caterpillars that the critical objector finds in hundreds on his peregrinations about his own garden—commonplace things which the experienced naturalist has long since got utterly tired of. But has your rash objector ever lighted upon that rare larva which lives among the periwinkles, and exactly imitates a periwinkle petal? Has he ever discovered those deceptive creatures which pretend for all the world to be leaves of lady's-bedstraw, or dress themselves up as flowers of buttonweed? Has he ever hit upon those immoral caterpillars which wriggle through life upon the false pretence that they are only the shadows of projecting ribs on the under surface of a full-grown lime leaf? No, not he; he passes them all by without one single glance of recognition; and when the painstaking naturalist who has hunted them every one down with lens and butterfly net ventures tentatively to describe their personal appearance, he comes up smiling with his great russet woolly bear comfortably nestling upon a green cabbage leaf, and asks you in a voice of triumphant demonstration, where is the trace of concealment or disguise in that amiable but very inedible insect? Go to, Sir Critic, I will have none of you; I only use you for a metaphorical marionette to set up and knock down again, as Mr. Punch in the street show knocks down the policeman who comes to arrest him, and the grimy black personage of sulphurous antecedents who pops up with a fizz through the floor of his apartment.

Queerer still than the caterpillars which pretend to be leaves or flowers for the sake of protection are those truly diabolical and perfidious Brazilian spiders which, as Mr. Bates observed, are brilliantly coloured with crimson and purple, but 'double themselves up at the base of leaf-stalks, so as to resemble flower buds, and thus deceive the insects upon which they prey.' There is something hideously wicked and cruel in this lowest depth of imitative infamy. A flower-bud is something so innocent and childlike; and to disguise oneself as such for purposes of murder and rapine argues the final abyss of arachnoid perfidy. It reminds one of that charming and amiable young lady in Mr. Robert Louis Stevenson's 'Dynamiter,' who amused herself in moments of temporary gaiety by blowing up inhabited houses, inmates and all, out of pure lightness of heart and girlish frivolity. An Indian mantis or praying insect, a little less wicked, though no less cruel than the spiders, deceives the flies who come to his arms under the false pretence of being a quiet leaf, upon which they may light in safety for rest and refreshment. Yet another abandoned member of the same family, relying boldly upon the resources of tropical nature, gets itself up as a complete orchid, the head and fangs being moulded in the exact image of the beautiful blossom, and the arms folding treacherously around the unhappy insect which ventures to seek for honey in its deceptive jaws.

Happily, however, the tyrants and murderers do not always have things all their own way. Sometimes the inoffensive prey turn the tables upon their torturers with distinguished success. For example, Mr. Wallace noticed a kind of sand-wasp, in Borneo, much given to devouring crickets; but there was one species of cricket which exactly reproduced the features of the sand-wasps, and mixed among them on equal terms without fear of detection. Mr. Belt saw a green leaf-like locust in Nicaragua, overrun by foraging ants in search of meat for dinner, but remaining perfectly motionless all the time, and evidently mistaken by the hungry foragers for a real piece of the foliage it mimicked. So thoroughly did this innocent locust understand the necessity for remaining still, and pretending to be a leaf under all advances, that even when Mr. Belt took it up in his hands it never budged an inch, but strenuously preserved its rigid leaf-like attitude. As other insects 'sham dead,' this ingenious creature shammed vegetable.

In order to understand how cases like these begin to arise, we must remember that first of all they start of necessity from very slight and indefinite resemblances, which succeed as it were by accident in occasionally eluding the vigilance of enemies. Thus, there are stick insects which only look like long round cylinders, not obviously stick-shaped, but rudely resembling a bit of wood in outline only. These imperfectly mimetic insects may often obtain a casual immunity from attack by being mistaken for a twig by birds or lizards. There are others, again, in which natural selection has gone a step further, so as to produce upon their bodies bark-like colouring and rough patches which imitate knots, wrinkles, and leaf-buds. In these cases the protection given is far more marked, and the chances of detection are proportionately lessened. But sharp-eyed birds, with senses quickened by hunger, the true mother of invention, must learn at last to pierce such flimsy disguises, and suspect a stick insect in the most innocent-looking and apparently rigid twigs. The final step, therefore, consists in the production of that extraordinary actor, the *Xeroxylus laceratus*, whose formidable name means no more than 'ragged dry-stick,' and which really mimics down to the minutest particular a broken twig, overgrown with mosses, liverworts, and lichens.

Take, on the other hand, the well-known case of that predaceous mantis which exactly imitates the white ants, and, mixing with them like one of their own horde, quietly devours a stray fat termite or so, from time to time, as occasion offers. Here we must suppose that the ancestral mantis happened to be somewhat paler and smaller than most of its fellow-tribesmen, and so at times managed unobserved to mingle with the white ants, especially in the shade or under a dusky sky, much to the advantage of its own appetite. But the termites would soon begin to observe the visits of their suspicious friend, and to note their coincidence with the frequent mysterious disappearance of a fellow-townswoman, evaporated into space, like the missing young women in neat cloth jackets who periodically vanish from the London suburbs. In proportion as their reasonable suspicions increased, the termites would carefully avoid all doubtful looking mantises; but, at the same time, they would only succeed in making the mantises which survived their inquisition grow more and more closely to resemble the termite pattern in all particulars. For any mantis which happened to come a little nearer the white ants in hue or shape would thereby be enabled to make a more secure meal upon his unfortunate victims; and so the very vigilance which the ants exerted against his vile deception would itself react in time against their own kind, by leaving only the most ruthless and indistinguishable of their foes to become the parents of future generations of mantises.

Once more, the beetles and flies of Central America must have learned by experience to get out of the way of the nimble Central American lizards with great agility, cunning, and alertness. But green lizards are less easy to notice beforehand than brown or red ones; and so the lizards of tropical countries are almost always bright green, with complementary shades of yellow, grey, and purple, just to fit them in with the foliage they lurk among. Everybody who has ever hunted the green tree-toads on the leaves of waterside plants on the Riviera must know how difficult it is to discriminate these brilliant leaf-coloured creatures from the almost identical background on which they rest. Now, just in proportion as the beetles and flies grow still more cautious, even the green lizards themselves

fail to pick up a satisfactory livelihood; and so at last we get that most remarkable Nicaraguan form, decked all round with leaf-like expansions, and looking so like the foliage on which it rests that no beetle on earth can possibly detect it. The more cunning you get your detectives, the more cunning do the thieves become to outwit them.

Look, again, at the curious life-history of the flies which dwell as unbidden guests or social parasites in the nests and hives of wild honey-bees. These burglarious flies are belted and bearded in the very selfsame pattern as the bumble-bees themselves; but their larvæ live upon the young grubs of the hive, and repay the unconscious hospitality of the busy workers by devouring the future hope of their unwilling hosts. Obviously, any fly which entered a bee-hive could only escape detection and extermination at the hands (or stings) of its outraged inhabitants, provided it so far resembled the real householders as to be mistaken at a first glance by the invaded community for one of its own numerous members. Thus any fly which showed the slightest superficial resemblance to a bee might at first be enabled to rob honey for a time with comparative impunity, and to lay its eggs among the cells of the helpless larvæ. But when once the vile attempt was fairly discovered, the burglars could only escape fatal detection from generation to generation just in proportion as they more and more closely approximated to the shape and colour of the bees themselves. For, as Mr. Belt has well pointed out, while the mimicking species would become naturally more numerous from age to age, the senses of the mimicked species would grow sharper and sharper by constant practice in detecting and punishing the unwelcome intruders.

It is only in external matters, however, that the appearance of such mimetic species can ever be altered. Their underlying points of structure and formative detail always show to the very end (if only one happens to observe them) their proper place in a scientific classification. For instance, these same parasitic flies which so closely resemble bees in their shape and colour have only one pair of wings apiece, like all the rest of the fly order, while the bees of course have the full complement of two pairs, an upper and an under, possessed by them in common with all other well-conducted members of the hymenopterous family. So, too, there is a certain curious American insect, belonging to the very unsavoury tribe which supplies London lodging-houses with one of their most familiar entomological specimens; and this cleverly disguised little creature is banded and striped in every part exactly like a local hornet, for whom it evidently wishes itself to be mistaken. If you were travelling in the wilder parts of Colorado you would find a close resemblance to Buffalo Bill was no mean personal protection. Hornets, in fact, are insects to which birds and other insectivorous animals prefer to give a very wide berth, and the reason why they should be imitated by a defenceless beetle must be obvious to the intelligent student. But while the vibrating wing-cases of this deceptive masquerader are made to look as thin and hornet-like as possible, in all underlying points of structure any competent naturalist would see at once that the creature must really be classed among the noisome Hemiptera. I seldom trouble the public with a Greek or Latin name, but on this occasion I trust I may be pardoned for not indulging in all the ingenuous bluntness of the vernacular.

Sometimes this effective mimicry of stinging insects seems to be even consciously performed by the tiny actors. Many creatures, which do not themselves possess stings, nevertheless endeavour to frighten their enemies by assuming the characteristic hostile attitudes of wasps or hornets. Everybody in England must be well acquainted with those common British earwig-looking insects, popularly known as the devil's coach-horses, which, when irritated or interfered with, cock up their tails behind them in the most aggressive fashion, exactly reproducing the threatening action of an angry scorpion. Now, as a matter of fact, the devil's coach-horse is quite harmless, but I have often seen, not only little boys and girls, but also chickens, small birds, and shrew-mice, evidently alarmed at his minatory attitude. So, too, the bumble-bee flies, which are inoffensive insects got up in sedulous imitation of various species of wild bee, flit about and buzz angrily in the sunlight, quite after the fashion of the insects they mimic; and when disturbed they pretend to get excited, and seem as if they wished to fly

in their assailant's face and roundly sting him. This curious instinct may be put side by side with the parallel instinct of shamming dead, possessed by many beetles and other small defenceless species.

Certain beetles have also been modified so as exactly to imitate wasps; and in these cases the beetle waist, usually so solid, thick, and clumsy, grows as slender and graceful as if the insects had been supplied with corsets by a fashionable West End house. But the greatest refinement of all is perhaps that noticed in certain allied species which mimic bees, and which have acquired useless little tufts of hair on their hind shanks to represent the dilated and tufted pollen-gathering apparatus of the true bees.

I have left to the last the most marvellous cases of mimicry of all—those noticed among South American butterflies by Mr. Bates, who found that certain edible kinds exactly resembled a handsome and conspicuous but bitter-tasted species 'in every shade and stripe of colour.' Several of these South American imitative insects long deceived the very entomologists; and it was only by a close inspection of their structural differences that the utter distinctness of the mimickers and the mimicked was satisfactorily settled. Scarcely less curious is the case of Mr. Wallace's Malayan orioles, two species of which exactly copy two pugnacious honey-suckers in every detail of plumage and coloration. As the honey-suckers are avoided by birds of prey, owing to their surprising strength and pugnacity, the orioles gain immunity from attack by their close resemblance to the protected species. When Dr. Sclater, the distinguished ornithologist, was examining Mr. Forbes's collections from Timorlaut, even his experienced eye was so taken in by another of these deceptive bird-mimicries that he classified two birds of totally distinct families as two different individuals of the same species.

Even among plants a few instances of true mimicry have been observed. In the stony African Karoo, where every plant is eagerly sought out for food by the scanty local fauna, there are tubers which exactly resemble the pebbles around them; and I have little doubt that our perfectly harmless English dead-nettle secures itself from the attacks of browsing animals by its close likeness to the wholly unrelated, but well-protected, stinging-nettle.

Finally, we must not forget the device of those animals which not merely assimilate themselves in colour to the ordinary environment in a general way, but have also the power of adapting themselves at will to whatever object they may happen to lie against. Cases like that of the ptarmigan, which in summer harmonises with the brown heather and grey rock, while in winter it changes to the white of the snow-fields, lead us up gradually to such ultimate results of the masquerading tendency. There is a tiny crustacean, the chameleon shrimp, which can alter its hue to that of any material on which it happens to rest. On a sandy bottom it appears grey or sand-coloured; when lurking among seaweed it becomes green, or red, or brown, according to the nature of its momentary background. Probably the effect is quite unconscious, or at least involuntary, like blushing with ourselves—and nobody ever blushes on purpose, though they do say a distinguished poet once complained that an eminent actor did not follow his stage directions because he omitted to obey the rubrical remark, 'Here Harold purples with anger.' The change is produced by certain automatic muscles which force up particular pigment cells above the others, green coming to the top on a green surface, red on a ruddy one, and brown or grey where the circumstances demand them. Many kinds of fish similarly alter their colour to suit their background by forcing forward or backward certain special pigment-cells known as chromatophores, whose various combinations produce at will almost any required tone or shade. Almost all reptiles and amphibians possess the power of changing their hue in accordance with their environment in a very high degree; and among certain tree-toads and frogs it is difficult to say what is the normal colouring, as they vary indefinitely from buff and dove-colour to chocolate-brown, rose, and even lilac.

But of all the particoloured reptiles the chameleon is by far the best known, and on the whole the most remarkable for his inconstancy of coloration. Like a lacertine Vicar of Bray, he varies incontinently from buff to blue, and from blue back to orange again, under stress of circumstances. The mechanism of this curious change is extremely complex. Tiny corpuscles of different pigments

are sometimes hidden in the depths of the chameleon's skin, and sometimes spread out on its surface in an interlacing network of brown or purple. In addition to this prime colouring matter, however, the animal also possesses a normal yellow pigment, and a bluish layer in the skin which acts like the iridium glass so largely employed by Dr. Salviati, being seen as straw-coloured with a transmitted light, but assuming a faint lilac tint against an opaque absorbent surface. While sleeping the chameleon becomes almost white in the shade, but if light falls upon him he slowly darkens by an automatic process. The movements of the corpuscles are governed by opposite nerves and muscles, which either cause them to bury themselves under the true skin, or to form an opaque ground behind the blue layer, or to spread out in a ramifying mass on the outer surface, and so produce as desired almost any necessary shade of grey, green, black, or yellow. It is an interesting fact that many chrysalids undergo precisely similar changes of colour in adaptation to the background against which they suspend themselves, being grey on a grey surface, green on a green one, and even half black and half red when hung up against pieces of particoloured paper.

Nothing could more beautifully prove the noble superiority of the human intellect than the fact that while our grouse are russet-brown to suit the bracken and heather, and our caterpillars green to suit the lettuce and the cabbage leaves, our British soldier should be wisely coated in brilliant scarlet to form an effective mark for the rifles of an enemy. Red is the easiest of all colours at which to aim from a great distance; and its selection by authority for the uniform of unfortunate Tommy Atkins reminds me of nothing so much as Mr. McClelland's exquisite suggestion that the peculiar brilliancy of the Indian river carps makes them serve 'as a better mark for kingfishers, terns, and other birds which are destined to keep the number of these fishes in check.' The idea of Providence and the Horse Guards conspiring to render any creature an easier target for the attacks of enemies is worthy of the decadent school of natural history, and cannot for a moment be dispassionately considered by a judicious critic. Nowadays we all know that the carp are decked in crimson and blue to please their partners, and that soldiers are dressed in brilliant red to please the æsthetic authorities who command them from a distance.

SEVEN-YEAR SLEEPERS

For many generations past that problematical animal, the toad-in-a-hole (literal, not culinary) has been one of the most familiar and interesting personages of contemporary folk-lore and popular natural history. From time to time he turns up afresh, with his own wonted perennial vigour, on paper at least, in company with the great sea-serpent, the big gooseberry, the shower of frogs, the two-headed calf, and all the other common objects of the country or the seaside in the silly season. No extraordinary natural phenomenon on earth was ever better vouched for—in the fashion rendered familiar to us by the Tichborne claimant—that is to say, no other could ever get a larger number of unprejudiced witnesses to swear positively and unreservedly in its favour. Unfortunately, however, swearing alone no longer settles causes offhand, as if by show of hands, 'the Ayes have it,' after the fashion prevalent in the good old days when the whole Hundred used to testify that of its certain knowledge John Nokes did not commit such and such a murder; whereupon John Nokes was forthwith acquitted accordingly. Nowadays, both justice and science have become more exacting; they insist upon the unpleasant and discourteous habit of cross-examining their witnesses (as if they doubted them, forsooth!), instead of accepting the witnesses' own simple assertion that it's all right, and there's no need for making a fuss about it. Did you yourself see the block of stone in which the toad is said to have been found, before the toad himself was actually extracted? Did you examine it all round to make quite sure there was no hole, or crack, or passage in it anywhere? Did you satisfy yourself after the toad was released from his close quarters that no such hole, or crack, or passage had been dexterously closed up, with intent to deceive, by plaster, cement, or other artificial composition? Did you ever offer the workmen who found it a nominal reward—say five shillings—for the first perfectly unanswerable specimen of a genuine unadulterated antediluvian toad? Have you got the toad now present, and can you produce him here in court (on writ of *habeas corpus* or otherwise), together with all the fragments of the stone or tree from which he was extracted? These are the disagreeable, prying, inquisitorial, I may even say insulting, questions with which a modern man of science is ready to assail the truthful and reputable gentlemen who venture to assert their discovery, in these degenerate days, of the ancient and unsophisticated toad-in-a-hole.

Now, the worst of it is that the gentlemen in question, being unfamiliar with what is technically described as scientific methods of investigation, are very apt to lose their temper when thus cross-questioned, and to reply, after the fashion usually attributed to the female mind, with another question, whether the scientific person wishes to accuse them of downright lying. And as nothing on earth could be further from the scientific person's mind than such an imputation, he is usually fain in the end to give up the social pursuit of postprandial natural history (the subject generally crops up about the same time as the after-dinner coffee), and to let the prehistoric toad go on his own triumphant way, unheeded.

As a matter of fact, nobody ever makes larger allowances for other people, in the estimate of their veracity, than the scientific inquirer. Knowing himself, by painful experience, how extremely difficult a matter it is to make perfectly sure you have observed anything on earth quite correctly, and have eliminated all possible chances of error, he acquires the fixed habit of doubting about one-half of whatever his fellow-creatures tell him in ordinary conversation, without for a single moment venturing to suspect them of deliberate untruthfulness. Children and servants, if they find that anything they have been told is erroneous, immediately jump at the conclusion that the person who told them meant deliberately to deceive them; in their own simple and categorical fashion they answer plumply, 'That's a lie.' But the man of science is only too well acquainted in his own person with the exceeding difficulty of ever getting at the exact truth. He has spent hours of toil, himself, in watching and observing the behaviour of some plant, or animal, or gas, or metal; and after repeated experiments, carefully designed to exclude all possibility of mistake, so far as he can foresee it, he at last believes

he has really settled some moot point, and triumphantly publishes his final conclusions in a scientific journal. Ten to one, the very next number of that same journal contains a dozen supercilious letters from a dozen learned and high-salaried professors, each pointing out a dozen distinct and separate precautions which the painstaking observer neglected to take, and any one of which would be quite sufficient to vitiate the whole body of his observations. There might have been germs in the tube in which he boiled the water (germs are very fashionable just at present); or some of the germs might have survived and rather enjoyed the boiling; or they might have adhered to the under surface of the cork; or the mixture might have been tampered with during the experimenter's temporary absence by his son, aged ten years (scientific observers have no right, apparently, to have sons of ten years old, except perhaps for purposes of psychological research); and so forth, *ad infinitum*. And the worst of it all is that the unhappy experimenter is bound himself to admit that every one of the objections is perfectly valid, and that he very likely never really saw what with perfect confidence he thought and said he had seen.

This being an unbelieving age, then, when even the book of Deuteronomy is 'critically examined,' let us see how much can really be said for and against our old friend, the toad-in-a-hole; and first let us begin with the antecedent probability, or otherwise, of any animal being able to live in a more or less torpid condition, without air or food, for any considerable period of time together.

A certain famous historical desert snail was brought from Egypt to England as a conchological specimen in the year 1846. This particular mollusk (the only one of his race, probably, who ever attained to individual distinction), at the time of his arrival in London, was really alive and vigorous; but as the authorities of the British Museum, to whose tender care he was consigned, were ignorant of this important fact in his economy, he was gummed, mouth downward, on to a piece of cardboard, and duly labelled and dated with scientific accuracy, '*Helix desertorum*, March 25, 1846.' Being a snail of a retiring and contented disposition, however, accustomed to long droughts and corresponding naps in his native sand-wastes, our mollusk thereupon simply curled himself up into the topmost recesses of his own whorls, and went placidly to sleep in perfect contentment for an unlimited period. Every conchologist takes it for granted, of course, that the shells which he receives from foreign parts have had their inhabitants properly boiled and extracted before being exported; for it is only the mere outer shell or skeleton of the animal that we preserve in our cabinets, leaving the actual flesh and muscles of the creature himself to wither unobserved upon its native shores. At the British Museum the desert snail might have snoozed away his inglorious existence unsuspected, but for a happy accident which attracted public attention to his remarkable case in a most extraordinary manner. On March 7, 1850, nearly four years later, it was casually observed that the card on which he reposed was slightly discoloured; and this discovery led to the suspicion that perhaps a living animal might be temporarily immured within that papery tomb. The Museum authorities accordingly ordered our friend a warm bath (who shall say hereafter that science is unfeeling!), upon which the grateful snail, waking up at the touch of the familiar moisture, put his head cautiously out of his shell, walked up to the top of the basin, and began to take a cursory survey of British institutions with his four eye-bearing tentacles. So strange a recovery from a long torpid condition, only equalled by that of the Seven Sleepers of Ephesus, deserved an exceptional amount of scientific recognition. The desert snail at once awoke and found himself famous. Nay, he actually sat for his portrait to an eminent zoological artist, Mr. Waterhouse; and a woodcut from the sketch thus procured, with a history of his life and adventures, may be found even unto this day in Dr. Woodward's 'Manual of the Mollusca,' to witness if I lie.

I mention this curious instance first, because it is the best authenticated case on record (so far as my knowledge goes) of any animal existing in a state of suspended animation for any long period of time together. But there are other cases of encysted or immured animals which, though less striking as regards the length of time during which torpidity has been observed, are much more closely analogous to the real or mythical conditions of the toad-in-a-hole. That curious West African mud-fish, the Lepidosiren (familiar to all readers of evolutionary literature as one of the most singular

existing links between fish and amphibians), lives among the shallow pools and broads of the Gambia, which are dried up during the greater part of the tropical summer. To provide against this annual contingency, the mud-fish retires into the soft clay at the bottom of the pools, where it forms itself a sort of nest, and there hibernates, or rather æstivates, for months together, in a torpid condition. The surrounding mud then hardens into a dry ball; and these balls are dug out of the soil of the rice-fields by the natives, with the fish inside them, by which means many specimens of lepidosiren have been sent alive to Europe, embedded in their natural covering. Here the strange fish is chiefly prized as a zoological curiosity for aquariums, because of its possessing gills and lungs together, to fit it for its double existence; but the unsophisticated West Africans grub it up on their own account as a delicacy, regardless of its claims to scientific consideration as the earliest known ancestor of all existing terrestrial animals. Now, the torpid state of the mud-fish in his hardened ball of clay closely resembles the real or supposed condition of the toad-in-a-hole; but with one important exception. The mud-fish leaves a small canal or pipe open in his cell at either end to admit the air for breathing, though he breathes (as I shall proceed to explain) in a very slight degree during his æstivation; whereas every proper toad-in-a-hole ought by all accounts to live entirely without either feeding or breathing in any way. However, this is a mere detail; and indeed, if toads-in-a-hole do really exist at all, we must in all probability ultimately admit that they breathe to some extent, though perhaps very slightly, during their long immurement.

And this leads us on to consider what in reality hibernation is. Everybody knows nowadays, I suppose, that there is a very close analogy between an animal and a steam-engine. Food is the fuel that makes the animal engine go; and this food acts almost exactly as coal does in the artificial machine. But coal alone will not drive an engine; a free draught of open air is also required in order to produce combustion. Just in like manner the food we eat cannot be utilised to drive our muscles and other organs unless it is supplied with oxygen from the air to burn it slowly inside our bodies. This oxygen is taken into the system, in all higher animals, by means of lungs or gills. Now, when we are working at all hard, we require a great deal of oxygen, as most of us have familiarly discovered (especially if we are somewhat stout) in the act of climbing hills or running to catch a train. But when we are doing very little work indeed, as in our sleeping hours, during which muscular movement is suspended, and only the general organic life continues, we breathe much more slowly and at longer intervals. However, there is this important difference (generally speaking) between an animal and a steam-engine. You can let the engine run short of coals and come to a dead standstill, without impairing its future possibilities of similar motion; you have only to get fresh coals, after weeks or months of inaction, and light up a fresh fire, when your engine will immediately begin to work again, exactly the same as before. But if an animal organism once fairly runs down, either from want of food or any other cause—in short, if it dies—it very seldom comes to life again.

I say 'very seldom' on purpose, because there are a few cases among the extreme lower animals where a water-haunting creature can be taken out of the water and can be thoroughly dried and desiccated, or even kept for an apparently unlimited period wrapped up in paper or on the slide of a microscope; and yet, the moment a drop of water is placed on top of it, it begins to move and live again exactly as before. This sort of thorough-going suspended animation is the kind we ought to expect from any well-constituted and proper-minded toad-in-a-hole. Whether anything like it ever really occurs in the higher ranks of animal life, however, is a different question; but there can be no doubt that to some slight extent a body to all intents and purposes quite dead (physically speaking) by long immersion in water—a drowned man, for example—may really be resuscitated by heat and stimulants, applied immediately, provided no part of the working organism has been seriously injured or decomposed. Such people may be said to be *pro tem.* functionally, though not structurally, dead. The heart has practically ceased to beat, the lungs have ceased to breathe, and physical life in the body is temporarily extinct. The fire, in short, has gone out. But if only it can be lighted again before any serious change in the system takes place, all may still go on precisely as of old.

Many animals, however, find it convenient to assume a state of less complete suspended animation during certain special periods of the year, according to the circumstances of their peculiar climate and mode of life. Among the very highest animals, the most familiar example of this sort of semi-torpidity is to be found among the bears and the dormice. The common European brown bear is a carnivore by descent, who has become a vegetarian in practice, though whether from conscientious scruples or mere practical considerations of expediency, does not appear. He feeds chiefly on roots, berries, fruits, vegetables, and honey, all of which he finds it comparatively difficult to procure during winter weather. Accordingly, as everyone knows, he eats immoderately in the summer season, till he has grown fat enough to supply bear's grease to all Christendom. Then he hunts himself out a hollow tree or rock-shelter, curls himself up quietly to sleep, and snores away the whole livelong winter. During this period of hibernation, the action of the heart is reduced to a minimum, and the bear breathes but very slowly. Still, he does breathe, and his heart does beat; and in performing those indispensable functions, all his store of accumulated fat is gradually used up, so that he wakes in spring as thin as a lath and as hungry as a hunter. The machine has been working at very low pressure all the winter: but it *has* been working for all that, and the continuity of its action has never once for a moment been interrupted. This is the central principle of all hibernation; it consists essentially of a very long and profound sleep, during which all muscular motion, except that of the heart and lungs, is completely suspended, while even these last are reduced to the very smallest amount compatible with the final restoration of full animal activity.

Thus, even among warm-blooded animals like the bears and dormice, hibernation actually occurs to a very considerable degree; but it is far more common and more complete among cold-blooded creatures, whose bodies do not need to be kept heated to the same degree, and with whom, accordingly, hibernation becomes almost a complete torpor, the breathing and the action of the heart being still further reduced to very nearly zero. Mollusks in particular, like oysters and mussels, lead very monotonous and uneventful lives, only varied as a rule by the welcome change of being cut out of their shells and eaten alive; and their powers of living without food under adverse circumstances are really very remarkable. Freshwater snails and mussels, in cold weather, bury themselves in the mud of ponds or rivers; and land-snails hide themselves in the ground or under moss and leaves. The heart then ceases perceptibly to beat, but respiration continues in a very faint degree. The common garden snail closes the mouth of his shell when he wants to hibernate, with a slimy covering; but he leaves a very small hole in it somewhere, so as to allow a little air to get in, and keep up his breathing to a slight amount. My experience has been, however, that a great many snails go to sleep in this way, and never wake up again. Either they get frozen to death, or else the respiration falls so low that it never picks itself up properly when spring returns. In warm climates, it is during the summer that mollusks and other mud-haunting creatures go to sleep; and when they get well plastered round with clay, they almost approach in tenacity of life the mildest recorded specimens of the toad-in-a-hole.

For example, take the following cases, which I extract, with needful simplifications, from Dr. Woodward.

'In June 1850, a living pond mussel, which had been more than a year out of water, was sent to Mr. Gray, from Australia. The big pond snails of the tropics have been found alive in logs of mahogany imported from Honduras; and M. Caillaud carried some from Egypt to Paris, packed in sawdust. Indeed, it isn't easy to ascertain the limit of their endurance; for Mr. Laidlay, having placed a number in a drawer for this very purpose, found them alive after *five years'* torpidity, although in the warm climate of Calcutta. The pretty snails called *cyclostomas*, which have a lid to their shells, are well known to survive imprisonments of many months; but in the ordinary open-mouthed land-snails such cases are even more remarkable. Several of the enormous tropical snails often used to decorate cottage mantelpieces, brought by Lieutenant Greaves from Valparaiso, revived after being packed, some for thirteen, others for twenty months. In 1849, Mr. Pickering received from Mr. Wollaston a basketful of Madeira snails (of twenty or thirty different kinds), three-fourths of which proved to be

alive, after several months' confinement, including a sea voyage. Mr. Wollaston has himself recorded the fact that specimens of two Madeira snails survived a fast and imprisonment in pill-boxes of two years and a half duration, and that large numbers of a small species, brought to England at the same time, were *all* living after being inclosed in a dry bag for a year and a half.'

Whether the snails themselves liked their long deprivation of food and moisture we are not informed; their personal tastes and inclinations were very little consulted in the matter; but as they and their ancestors for many generations must have been accustomed to similar long fasts during tropical droughts, in all likelihood they did not much mind it.

The real question, then, about the historical toad-in-a-hole narrows itself down in the end merely to this—how long is it credible that a cold-blooded creature might sustain life in a torpid or hibernating condition, without food, and with a very small quantity of fresh air, supplied (let us say) from time to time through an almost imperceptible fissure? It is well known that reptiles and amphibians are particularly tenacious of life, and that some turtles in particular will live for months, or even for years, without tasting food. The common Greek tortoise, hawked on barrows about the streets of London and bought by a confiding British public under the mistaken impression that its chief fare consists of slugs and cockroaches (it is really far more likely to feed upon its purchaser's choicest seakale and asparagus), buries itself in the ground at the first approach of winter, and snoozes away five months of the year in a most comfortable and dignified torpidity. A snake at the Zoo has even been known to live eighteen months in a voluntary fast, refusing all the most tempting offers of birds and rabbits, merely out of pique at her forcible confinement in a strange cage. As this was a lady snake, however, it is possible that she only went on living out of feminine obstinacy, so that this case really counts for very little.

Toads themselves are well known to possess all the qualities of mind and body which go to make up the career of a successful and enduring anchorite. At the best of times they eat seldom and sparingly, while a forty days' fast, like Dr. Tanner's, would seem to them but an ordinary incident in their everyday existence. In the winter they hibernate by burying themselves in the mud, or by getting down cracks in the ground. It is also undoubtedly true that they creep into holes wherever they can find one, and that in these holes they lie torpid for a considerable period. On the other hand, there is every reason to believe that they cannot live for more than a certain fixed and relatively short time entirely without food or air. Dr. Buckland tried a number of experiments upon toads in this manner—experiments wholly unnecessary, considering the trivial nature of the point at issue—and his conclusion was that no toad could get beyond two years without feeding or breathing. There can be very little doubt that in this conclusion he was practically correct, and that the real fine old crusted antediluvian toad-in-a-hole is really a snare and a delusion.

That, however, does not wholly settle the question about such toads, because, even though they may not be all that their admirers claim for them, they may yet possess a very respectable antiquity of their own, and may be very far from the category of mere vulgar cheats and impostors. Because a toad is not as old as Methuselah, it need not follow that he may not be as old as Old Parr; because he does not date back to the Flood, it need not follow that he cannot remember Queen Elizabeth. There are some toads-in-a-hole, indeed, which, however we may account for the origin of their legend, are on the very face of it utterly incredible. For example, there is the favourite and immensely popular toad who was extracted from a perfectly closed hole in a marble mantelpiece. The implication of the legend clearly is that the toad was coeval with the marble. But marble is limestone, altered in texture by pressure and heat, till it has assumed a crystalline structure. In other words we are asked to believe that that toad lived through an amount of fiery heat sufficient to burn him up into fine powder, and yet remains to tell the tale. Such a toad as this obviously deserves no credit. His discoverers may have believed in him themselves, but they will hardly get other people to do so.

Still, there are a great many ways in which it is quite conceivable that toads might get into holes in rocks or trees so as to give rise to the common stories about them, and might even manage to live

there for a considerable time with very small quantities of food or air. It must be remembered that from the very nature of the conditions the hole can never be properly examined and inspected until after it has been split open and the toad has been extracted from it. Now, if you split open a tree or a rock, and find a toad inside it, with a cavity which he exactly fills, it is extremely difficult to say whether there was or was not a fissure before you broke the thing to pieces with your hatchet or pickaxe. A very small fissure indeed would be quite sufficient to account for the whole delusion; for if the toad could get a little air to breathe slowly during his torpid period, and could find a few dead flies or worms among the water that trickled scantily into his hole, he could manage to drag out a peaceful and monotonous existence almost indefinitely. Here are a few possible cases, any one of which will quite suffice to give rise to at least as good a toad-in-the-hole as ninety-nine out of a hundred published instances.

An adult toad buries himself in the mud by a dry pond, and gets coated with a hard solid coat of sun-baked clay. His nodule is broken open with a spade, and the toad himself is found inside, almost exactly filling the space within the cavity. He has only been there for a few months at the outside; but the clay is as hard as a stone, and to the bucolic mind looks as if it might have been there ever since the Deluge. Good blue lias clay, which dries as solid as limestone, would perform this trick to perfection; and the toad might easily be relegated accordingly to the secondary ages of geology. Observe, however, that the actual toads so found are not the geological toads we should naturally expect under such remarkable circumstances, but the common everyday toads of modern England. This shows a want of accurate scientific knowledge on the part of the toads which is truly lamentable. A toad who really wished to qualify himself for the post ought at least to avoid presenting himself before a critical eye in the foolish guise of an embodied anachronism. He reminds one of the Roman mother in a popular burlesque, who suspects her son of smoking, and vehemently declares that she smells tobacco, but, after a moment, recollects the historical proprieties, and mutters to herself, apologetically, 'No, not tobacco; that's not yet invented.' A would-be silurian or triassic toad ought, in like manner, to remember that in the ages to whose honours he aspires his own amphibian kind was not yet developed. He ought rather to come out in the character of a ceratodus or a labyrinthodon.

Конец ознакомительного фрагмента.