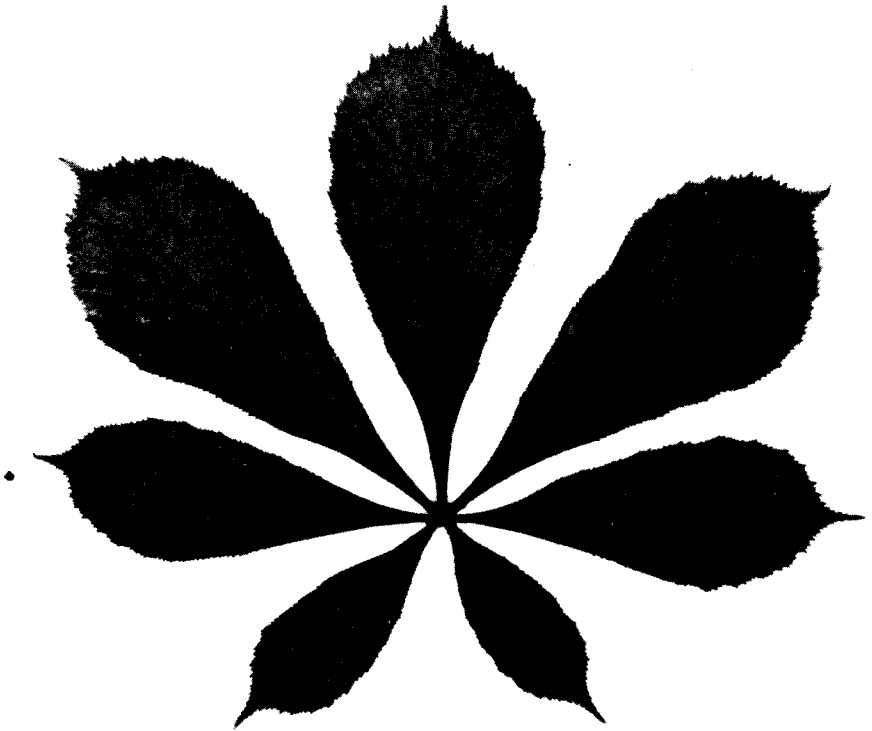


The illusion of beauty

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“Beauty is truth, truth beauty” to the poet. But a biologist is bound, I think, to regard beauty—at least man-made beauty—as something closer to a lie. A lie, admittedly, of a unique kind, but a kind to which both men and animals are specially vulnerable.

If I give a hungry dog a solution of saccharine it will lap it up; if I show a cock robin a bundle of feathers with a red patch on its underside the robin will attack it; and if I show a man an abstract painting or play him a piece of music he will, if he thinks it beautiful, stop to watch or listen. There is, I believe, a formal similarity in all these cases. In each we have an animal performing a useful and relevant piece of behaviour towards an *inappropriate* sensory stimulus. But there is, I agree, a rather basic difference, namely that in the first two cases we have a good scientific explanation of what is going on, while in the third we’re almost ignorant. With the saccharine and the red-breasted bundle of feathers we know what the artificial, ‘illusory’, stimulus corresponds to in nature and we know how the dog’s or the robin’s behaviour would in normal circumstances contribute to its biological survival.

Saccharine tastes like sugar and it is biologically adaptive for a hungry dog to eat sugar; the bundle of feathers looks like another male robin and it is biologically adaptive for a robin to drive an intruder from his territory. But in the case of man's response to a beautiful work of art we have no clear idea either of what the work of art corresponds to in nature, nor of why it should be biologically adaptive for men to *like* the natural counterpart (whatever it may be).

It is with these fundamental questions of the biology of aesthetics that my paper is concerned. I plan first to try to define the particular quality which things of beauty have in common, and then to suggest a possible reason why men—and, for that matter, animals—should be attracted to the presence of that quality.

Seventy years before Darwin published the *Origin of Species* the Scottish philosopher Thomas Reid suggested how a modern biologist might proceed: "By a careful examination of the objects to which Nature hath given this amiable quality [of Beauty], we may perhaps discover some real excellence in the object, or at least some valuable purpose that is served by the effect which it produces upon us. This instinctive sense of beauty, in different species of animals, may differ as much as the external sense of taste, and in each species be adapted to its manner of life" (Reid, 1785).

Yet it is easy to dismiss Reid's manifesto. The injunction to 'examine carefully' the objects of beauty would be fine were it true that different individuals of the same species did find the *same* objects beautiful. But one of the central problems of aesthetics has always been that, in man at least, there is no clear consensus. The point was forcefully made by Maureen Duffy in her review of Jane Goodall's book *In the Shadow of Man*. Jane Goodall had written "But what if a chimpanzee wept tears when he heard Bach thundering from a cathedral organ?", to which Miss Duffy replied "What indeed if an Amazon pigmy or a 19th century factory hand wept tears at such a minority western cultural phenomenon?"

The way out for some critics confronted with the diversity of individual taste has been to react with the cynicism of Clive Bell, stating that "any system of aesthetics which pretends to be based on some objective truth is so palpably ridiculous as not to be worth discussing" (Bell, 1913). But William Empson (1930) scorned such anti-rationality: "Critics", he wrote, "are of two sorts: those who merely relieve themselves against the flower of beauty, and those, less continent, who afterwards scratch it up. I myself, I must confess, aspire to the second of these classes; unexplained beauty arouses an irritation in me..." My own sympathies lie, of course, with Empson. But the roots of the flower of beauty may go deep and if we are to expose them undamaged we should start scratching at some distance from the stem.

The problem of looking for common principles behind apparent diversity is not peculiar to aesthetics. Very similar problems have arisen in other disciplines, notably in linguistics and in anthropology. The breakthrough in these fields came through applying the methods of *structuralism*. I believe that a structuralist approach is the key to a science of aesthetics.

In his discussion of the analysis of myth, Levi-Strauss (1963) wrote as follows: "For the contradiction which we face is very like that which in earlier times brought considerable worry to the first philosophers concerned with linguistic problems... Ancient philosophers did notice that certain sequences of sounds were associated with definite meanings, and they earnestly aimed at discovering the reason for the linkage between *these* sounds and *that* meaning. Their attempt however was thwarted from the beginning by the fact that the same sounds were equally present in other languages although the meaning they conveyed was entirely different. The contradiction was surmounted only by the discovery that it is the combination of

sounds, not the sounds themselves, which provides the significant data". He went on: "If there is a meaning to be found in mythology, it cannot reside in the isolated elements which enter into the composition of a myth, but only in the way those elements are combined".

Following this lead, it would seem fruitful to search for the essence of beauty in the *relations* formed between the perceived elements. As it happens, just such an approach was proposed in 1808 by the philosopher Herbart: "The conclusion is that *each* element of the approved or distasteful whole is, in isolation, indifferent; in a word, the *material* is indifferent, but the *form* comes under the aesthetic judgement Those judgements which are commonly conceived under the name of taste are the result of the perfect apprehension of relations formed by a complexity of elements".

But it is one thing to point to the importance of relations, another to say *what* relations are important and another still to say *why*.

Levi-Strauss himself, in so far as he has had anything to say about aesthetics, has tended to regard works of art merely as a special sort of myth. For him the work of art is a "system of signs" which conveys a message. To understand the message we must make an equation between the *relations* among the signs and the *relations* among the things signified.

No doubt such myth-like works of art exist. We know for instance of a Chinese scholar, Lyng Lun, who 2500 years before Christ strung together five tones of oriental music, explained them, formed them into a system, and gave them strange names, every tone being called after a social stratum from the emperor down to the peasant: *kong*, the emperor; *chang*, the minister; *kyo*, the burgher; *tchi*, the official; *yu*, the peasant (Pahlen, 1963). Within such a system almost any piece of music must, if interpreted in a structural way, have carried a potential social message. In the field of graphic art, Caroline Humphrey (1971) has recently shown how the magical drawings of the Mongolian Buryat people embody structuralist devices which make the drawings effectively into 'visual texts'. And almost certainly similar sign-systems are at work within the mainstream of western painting. McManus and I found evidence that Rembrandt, for instance, may have made use of a simple sign system in his painted portraits, whereby the social status of the subject of the portrait was indicated by the left or right turn of his head (Humphrey and McManus, 1973).

But be that as it may, these sign systems where they exist serve primarily a semantic function, not an aesthetic one. They do not lend *beauty* to a work of art. If structuralism is to help in pointing to relations which are *aesthetically* satisfying it must take a different turn.

Few people have written with more insight about beauty than the poet Gerard Manley Hopkins. Hopkins is hardly to be called a 'structuralist' since the name had still to be invented in his lifetime, yet not only did he see that the essence of beauty lies in certain relations but he attempted explicitly to define what those relations are. In 1865 he wrote a paper for his tutor at Oxford in the form of a 'platonic dialogue' between a student and a professor in a college garden. The two of them fall to discussing the beauty of the garden and they dwell in particular on the leaves of a chestnut tree. The professor holds forth on the structural relations within the chestnut-fan, pointing out how each leaf is a variation with a difference of the common pattern, how the overall shape of the fan shows mirror symmetry, the left half being a perfect reflection of the right, whilst in other ways the internal reflections are tantalisingly irregular—each of the large oblique leaves, for instance, being reflected by an exact copy of itself in miniature; and he discusses too the relation between the leaves of the chestnut and the leaves of other trees, drawing attention to the way in which the chestnut leaf, being fatter at the distal than the

central end, is the opposite shape to the common shape shown, say, by the leaf of an elm. The professor continues:

"Then the beauty of the oak and the chestnut-fan and the sky is a mixture of likeness and difference or agreement and disagreement or consistency and variety or symmetry and change".

"It seems so, yes".

"And if we did not feel the likeness we should not feel them so beautiful, or if we did not feel the difference we should not feel them so beautiful. The beauty we find is from the comparison we make of the things with themselves, seeing their likeness and difference, is it not?"

Before long they move on to the subject of poetry:

"Rhythm therefore is likeness tempered with difference And the beauty of rhythm is traced to the same causes as that of the chestnut-fan, is it not so?"

"What is rhyme? Is it not an agreement of sound—with a slight disagreement?"

"In fact it seems to me that rhyme is the epitome of our principle. All beauty may by a metaphor be called rhyme, may it not?"

In 1909 Christiansen coined the word "differenzqualität" to refer to what Hopkins had called "likeness tempered with difference". And shortly afterwards the writers of the school of Russian Formalism propounded a system of aesthetics based on essentially similar structuralist ideas. In England the philosopher Whitehead wrote of rhythm: "The essence of rhythm is the fusion of sameness and novelty; so that the whole never loses the essential unity of the pattern, while the parts exhibit the contrast arising from the novelty of their detail. A mere recurrence kills rhythm as does a mere confusion of differences. A crystal lacks rhythm from excessive pattern, while a fog is unrhythmic in that it exhibits a patternless confusion of detail" (Whitehead, 1919).

Here then we have the beginnings of an answer as to what relations lie at the heart of beauty. "All beauty may by a metaphor be called rhyme". What is rhyme like? Well, let us have an example:

cat rhymes with *mat*,

cat does not rhyme with *table*,

cat does not rhyme with *cat*.

Taking rhyme as the paradigm of beauty, let me turn at once to the fundamental question: Why do we *like* the relation which rhyme epitomises? What is the biological advantage of seeking out rhyming elements in the environment?

The answer I propose is this: considered as a biological phenomenon, aesthetic preferences stem from a predisposition among animals and men to seek out experiences through which they may *learn to classify* the objects in the world about them. Beautiful 'structures' in nature or in art are those which facilitate the task of classification by presenting evidence of the 'taxonomic' relations between things in a way which is informative and easy to grasp.

Three steps are needed to justify this argument. First, an explanation of why classification should be important to biological survival. Second, an explanation of why particular structures such as those exemplified by rhyme should be the best way of presenting material for classification. Third, evidence that men and animals have a propensity to classify things and that they are attracted in particular to the presence of rhyme.

1 Why is classification important?

In order to be effective agents in the natural world, animals require the guidance of a 'world model', an internal representation of what the world is like and how it works. This model enables them to predict in advance the characteristics of

'recognisable' objects, to anticipate the likely course of events in the environment, and to plan their behaviour accordingly. The role of classification in this context is to help organise sensory experience and to introduce an essential economy into the description of the world. An effective classification system is one which divides the objects in the world up into discrete categories according to criteria which make an object's membership of any particular class a relevant datum for guiding behaviour: the objects in any one class may differ in detail but they should share certain essential features which give them a common significance for the animal. Such a classification system will reduce the 'thought load' on the animal, expedite new learning and allow rapid and efficient extrapolation from one set of circumstances to another.

We may be sure that any animal which could not or did not classify things effectively—which could not recognise the likenesses between things—would not have a chance of surviving for long. And so, in the course of evolution, there must have been very strong pressures on animals to perfect techniques of classification, on a par perhaps with those that have made eating and sex evolve into such efficient and dominant activities. I shall argue that, just as with eating or with sex, an activity as vital as classification was bound to evolve to be a *source of pleasure* to the animal. Both animals and men can, after all, be relied on to do best what they enjoy doing.

But I am anticipating. The next step of the argument is to demonstrate the relevance of rhyme.

2 On what kind of 'evidence' are classification systems based?

The young animal's task of imposing a system of categories upon the world is comparable to that which faces a zoological taxonomist when he sets out to classify the animal kingdom. We may assume that the goal before the animal is in some sense 'given', that he has an innate predisposition to develop a system of categories, but that the actual system he arrives at must be largely based upon his own experience. How does the animal—and the zoologist—proceed? I would suggest he works through the following stages:

- (i) he makes a preliminary reconnaissance and from this forms certain hunches about how his world is constituted, what kinds of classes of objects it contains and what are the distinguishing criteria,
- (ii) he seeks further evidence to test the 'validity' of these criteria and at the same time to acquaint himself with the diversity which may exist *within* each class,
- (iii) to the extent that his criteria prove successful he adopts them as permanent guidelines for future classification, while to the extent that they fail he abandons or revises them.

Successful criteria will on the whole be those which yield a system of classification which is at once *unambiguous*, i.e. objects belong to one class only; *exhaustive*, i.e. every object belongs to some class or another; and *useful*, i.e. objects in the same class may be treated for some practical purpose as identical. Thus a zoologist who comes up with a simple classification of animals which divides them into two classes, vertebrates and invertebrates, has produced a scheme which meets all three requirements. But a division of animals into meat-eaters and plant-eaters, for example, fails to be unambiguous since there are some animals which eat both; a division into swimming animals and flying animals fails to be exhaustive since there are some animals which neither swim nor fly; a division into animals which live in zoos and animals which live freely fails to be useful since there is no purpose (for a zoologist) in treating the members of either of these classes as identical.

I want to examine the process of seeking evidence to test the criteria for distinguishing between classes. Let me continue with a zoological example. Imagine

that the taxonomist is concerned to classify warm-blooded vertebrates. In making a preliminary survey he meets a cat, a dog, and a hen, and he notices that the cat and the dog are covered with hair whilst the hen is covered with feathers. On this basis he sets up two putative classes, called mammals and birds, defined respectively as animals which have hair and as animals which have feathers. His next step is to look for further examples to test his ideas. Suppose that the next animal he meets is a horse and then a rabbit. Applying his criteria he discovers that these animals fit neatly into the category of mammals. Then perhaps he meets a sparrow, then a mouse, and then a parrot and he is pleased to find that whilst the mouse is clearly a mammal the sparrow and the parrot fit the definition of a bird. Looking further he meets another cat, but on this occasion he pays it little attention since it tells him nothing new. And later on he meets an octopus, but since this is not a warm-blooded vertebrate it can provide no evidence either way and again he shows no interest in it. Slowly, by accumulating evidence, he establishes that his criteria do indeed serve to make unambiguous distinctions, and at the same time he becomes familiar with the range of different animals that fall within each class. It remains of course for him to show that his classification is a useful one, i.e. that it serves some purpose to group mice and horses or hens and parrots together.

Certain principles of how to gather evidence emerge. The zoologist needs to prove that his criteria serve both to *group* different animals together and to *separate* one group from another. Accordingly he looks for two kinds of examples: (i) sets of animals which share a particular distinctive feature, and (ii) other sets of animals which share a contrasting feature. Thus he looks in effect for 'likeness tempered with difference', 'rhyme', and for *contrast* between sets of rhyming elements. But he is not interested in seeing repetitive examples of the same animal, nor in seeing an animal which is altogether different from the others and thus lies beyond the scope of his classification—"a mere recurrence kills rhyme, as does a mere confusion of differences".

Pursuing this metaphor of the taxonomic 'poem':

horse 'rhymes' with dog,
 hen 'rhymes' with parrot,
 horse and dog contrast with hen and parrot,
 horse does not rhyme with horse, nor hen with hen,
 neither horse nor dog nor hen nor parrot rhyme or
 contrast in a relevant way with octopus.

Now to the nub of my argument. I believe that the same principles which apply to the zoological taxonomist apply to every animal who needs to classify the world about him. If it is helpful for the taxonomist to look for 'rhymes' in his materials, so it is helpful for the animal to do so. It is for this reason that we have evolved to respond to the relation of beauty which rhyme epitomises. At one level we take pleasure in the abstract structure of rhyme as a model of well-presented evidence, and at another we delight in particular examples of rhyme as sources of new insight into how things are related and divided.

Let me move on to the next stage of the argument and give evidence that men and animals do indeed take pleasure in classifying things and, on that account, are especially attracted to rhyme.

3 The propensity to classify—and the love of 'rhyme'

Aristotle once condescendingly remarked "Learning is very agreeable, not only to philosophers but also to other men" (Poetics IV). What evidence is there that classification—the core of learning—is agreeable to men and to animals also?

For experimental evidence of a general kind we may look to the many studies of exploratory behaviour. Comparative psychologists have found that, in almost every species studied, animals will work to be exposed to novel sensory stimuli. Indeed, 'stimulus novelty' is the most universal reinforcer of behaviour which is known. In my own work with monkeys I have found that monkeys will even work to look at abstract paintings and prefer such pictures to pictures of appetising, but familiar, food. Recent experiments strongly suggest that when monkeys work to look at pictures they do so because the picture presents them with a challenge to incorporate new material into their model of the world: pictures of familiar objects hold their attention far less long than pictures of objects for which they have no readily available category. But while they do not spend long on thoroughly familiar things, neither, I should say, are they interested in looking at a total jumble. And that leads me on to the question of rhyme.

The significance of rhyme was in fact recognised by experimental psychologists some time ago, though they called it—and still call it—by the cumbersome name of 'stimulus discrepancy'. In the early 1950s a theory was propounded called the 'discrepancy theory', the gist of which is that men who have been exposed for some time to a particular sensory stimulus respond with pleasure to minor variations from that stimulus (McClelland *et al.*, 1953). And confirmatory evidence has come from a number of studies. For instance, human babies who have been made familiar with a particular 'abstract' visual pattern take pleasure in seeing new patterns which are minor transformations of the original (Kagan, 1970). Among animals, it has been shown, for instance, that chicks who have been 'imprinted' early in life on an artificial stimulus soon come to prefer new stimuli which are slightly different from the one they are familiar with (Bateson, 1973). Neither babies nor chicks are attracted to stimuli which are wholly unrelated to what they have already seen.

I am pursuing my own research with monkeys along these lines. But this is not the place to report the details of experiments. And it is not in fact to experimental evidence that I want to give most weight in this discussion. For there is much in the evidence of anecdote and common experience to substantiate the view that men, at least, take pleasure in one form or another of classificatory activity.

As we might expect, the tendency is most pronounced in children. Children have a thirst to know 'what things are'. They love especially to learn *names*, and to prove the power of their vocabulary with new examples. Picture books for children often serve no other purpose than as practical exercises in classification. The same animals—rabbits, hens, pigs—appear in the pictures again and again. "Where's the bunny?" asks the child's mother, and with a smile of pleasure the child points a finger to yet another rabbit which rhymes with those he has already seen. The ability to name becomes tangible evidence of the ability to classify, and when the name for an object is not available children will often invent their own. The poet Richard Wilbur tells this story: "... I took my three-year-old son for a walk in the Lincoln woods. As we went along I identified what trees and plants I could After a while we came to a stretch of woods-floor thick with those three-inch evergreen plants one sees everywhere in New England woods, and I was obliged to confess I didn't know what to call them. My three-year-old stepped promptly into the breach. 'They're millows', he told me, 'Look at all the millows'. No hesitation; no bravado; with a serene Adamite confidence he had found a name for something nameless and brought it under our verbal control. Millows they were" (Wilbur, 1956).

Yet while children may manifest the tendency most clearly, adult men often show an equally innocent delight in classifying, not least in naming. A poem by Robert Bridges called "The idle flowers" mentions 83 different flowers by name in a poem only 84 lines long! And the reverse of the coin is the ridicule that is heaped on

people who make mistakes with names. A. P. Herbert tells a story against himself, again to do with flowers: "The anemias are wonderful", I said, 'And those arthritis, always so divine at this time of the year'" (quoted in Hadfield, 1936).

The concern with naming, carried to such an extreme in Bridge's poem, finds echoes in another remarkable aspect of human behaviour—the passion for *collecting*. Collecting, whether the material of the collection be postage stamps, antiquarian books or engine numbers, is to my mind yet another manifestation of the pleasure men take in classification.

Curiously, there is only one psychologist I know of who has deemed collecting worthy of comment. That man, surprisingly enough, is Pavlov. In an essay called "The reflex of purpose" he characterised collecting as "the aspiration to gather together the parts or units of a great whole or of an enormous classification, usually unattainable", and went on: "If we consider collecting in all its variations, it is impossible not to be struck with the fact that on account of this passion there are accumulated often completely trivial and worthless things, which represent absolutely no value from any point of view other than the gratification of the propensity to collect. Notwithstanding the worthlessness of the goal, every one is aware of the energy, the occasional unlimited self-sacrifice, with which the collector achieves his purpose. He may become a laughing-stock, a butt of ridicule, a criminal, he may suppress his fundamental needs, all for the sake of his collection" (Pavlov, 1928).

Collecting, though its practitioners are not usually credited with aesthetic sensitivity, is not, I believe, far removed from the appreciation of beauty. Consider for a moment the nature of a typical collection, say a stamp collection. Postage stamps are, in structuralist terms, like man-made flowers: they are divided into 'species', of which the distinctive feature is the country of origin, while within each species there exists tantalising variation. The stamp collector sets to work to classify them. He arranges his stamps in an album, a page for the species of each country. The stamps on each page 'rhyme' with each other, while they contrast with those on other pages.

But Pavlov was right: stamp collecting is a worthless activity. As we have moved through my examples, from an infant animal learning to recognise the objects in the world about him, to a child learning to name pictures in a book, to a man sticking stamps in an album, we have moved further and further from activities which have any obvious biological function. They are all, I submit, examples of the propensity to classify, but with each example the classification seems to have less and less direct survival value.

We should not be surprised. Earlier, I compared the pleasure men get from classification with the pleasure they get from sexual activity. Now, though sex has a clear biological function, it goes without saying that not every particular example of sexual activity has in fact to be biologically relevant to be enjoyable. Indeed, much human sexual activity takes place at times when the woman, for natural or artificial reasons, is most unlikely to conceive. And so too the process of classification may give pleasure in its own right even when divorced from its proper biological context. Once Nature had set up men's brains the way she has, certain 'unintended' consequences followed—and we are in several ways the beneficiaries.

So let me turn, at last, to *beauty*—to examples of rhyme and contrast which people deem *aesthetically* attractive. I want first to consider not 'works of art' but certain natural phenomena which men call beautiful and yet which have no 'natural' value to us.

Among the wealth of examples of beauty in nature, I shall choose the case of flowers. Flowers have an almost universal appeal, to men of all cultures, all classes, and all ages. We grow them in gardens, decorate our houses and our bodies with

them, and above all value them as features of the natural landscape. They are regarded indeed as paragons of natural beauty, and I believe it is no accident that they are so admired, for in at least three ways flowers are the embodiment of 'visual rhyme'.

Consider first the static form of a simple flower such as a buttercup or daisy. The flower-head consists of a set of petals arranged in radial symmetry around a cluster of stamens, and the flower-head is carried on a stalk which bears a set of leaves. Petals, stamens, and leaves form three sets of contrasting rhyming elements: each petal differs in detail from the other members of its class yet shares their distinctive shape and colour, and the same is true for the stamens and the leaves; the features that serve to unite each set serve at the same time to separate one set from another. Secondly, consider the flower's *kinetic* form. The living flower is in a continual state of growth, changing its form from day to day. The transformations which occur as the flower buds, blossoms, and decays give rise to a temporal structure in which each successive form rhymes with the preceding one. Thirdly, consider groups of flowers. Typically each flowering plant bears several blooms, and plants of the same species tend to grow in close proximity, so that we are presented with a variety of related blooms on show together. But, more than this, groups of flowers of *different* species commonly grow alongside one another—daisies and buttercups beside each other in the field, violets and primroses together in the hedgerow. Thus while the flowers of one species rhyme with each other the rhyme is given added poignancy by the contrasting rhymes of different species. It is this last aspect that perhaps more than anything makes flowers so special to us. The flowers of different species are of necessity perceptually distinct in colour, form, and smell in order that they may command the loyalty of pollinating insects. Men neither eat their pollen nor collect their nectar, yet flowers provide us with a kind of nourishment—food for our minds, ideally suited to satisfy our hunger for classification.

But flowers have no monopoly of natural beauty. In fact almost wherever we come across organic forms we discover the structure of visual rhyme. Long before architects invented the *module*, Nature employed a similar design principle, basing her living creations on the principle of replication—at one level replication of structural elements within a single body, and at another replication of the body of the organism as a whole. But, at either level, the replicas are seldom, if ever, perfect copies: in the leaves of a tree, the spots of a leopard, the bodies of a flight of geese, we are presented with sets of 'variations on a theme'. And it is not only among living things we find such structures, for inanimate objects too tend to be shaped by physical forces into 'modular' forms—mountain peaks, pebbles on a beach, clouds, raindrops, ocean waves—each alike but different from the others. Thus, through its varied but coherent structure, a natural landscape can match the rhythmic beauty of a gothic church. Or of a musical symphony.

My discussion of 'art' must inevitably be brief, and I shall in fact take music as the paradigm. Among all the arts, music has traditionally been the medium for the purest expression of abstract structural relations. And 'rhyme', in the form of thematic variation, emerges as the fundamental principle—the stock-in-trade of nearly every musical composer. The composer presents us with, say, a simple melody, repeats it a few times and then launches into a series of variations, playing it on a different instrument, with different emphasis or in a different key, until eventually he returns to the original. But repetition of the same theme, albeit with variations, becomes in the long run relatively dull. As in poetry—as in every other 'taxonomic' activity—*contrast* is needed to bring home the unity of the rhyming elements, and the composer typically introduces a contrasting theme with its own variations. Thus we get in a simple piece such as a Chopin nocturne the following structure: two

distinct themes, I and II, arranged in the following way: I I II I II I. Taking the nocturne in E flat as an example, the first tune is repeated twice so that the main key and the main subject matter may be well established in the memory of the hearer. Then comes the second tune which is in the most nearly related key (so that the effect of the contrast is not lost because of too great dissimilarity). Then the two tunes alternate, while at each repetition small changes are introduced, in the form for instance of decorative arabesques in the righthand part. In more complex pieces, such as Beethoven sonatas, we get the composer introducing a 'development' section where the motifs of the first theme are picked up and rearranged until just at the point where the hearer may be in danger of losing track of what is going on order is restored by the 'recapitulation' of the first theme pure and simple.

'Sonata form' is to my mind a perfect example of an instructive and challenging exercise in classification. If I were an educational psychologist concerned with developing teaching machines for use in schools I would not, as the American behaviourists have done, base my machines on principles derived from experiments on how pigeons perform in Skinner boxes, but instead would turn directly to the hallowed principles of musical design.

And that brings me close to the end of my paper—but to an end, I should say, which is not altogether in tune with the beginning. I began by saying that man-made beauty is a lie. And so, in a sense, I believe it is. It was not for the sake of Beethoven sonatas that men evolved to take such a delight in classifying; to that extent, Beethoven merely capitalised on a human faculty which was developed for quite other reasons. But though it may be true that, at one level, we gain nothing of biological value from learning to classify the themes of a sonata, it does not necessarily follow that listening to a sonata has no function at all. For it can be argued that, at another level, through the experience of beauty in works of art we *learn to learn*. I implied as much just now when I suggested that psychologists might use music as a model for the design of teaching machines. If psychologists could learn from music how best to present evidence of the relations between things in a way that people will find easy to take in, it is equally possible that laymen might learn to do it for themselves. In that way the work of art would achieve a new importance, as a model of the way we should structure our experience wherever and whenever we need to acquire genuinely useful information.

Everyone has heard the argument that a training in Latin and Greek, however irrelevant to real life, is an excellent 'training for the mind'. How much better for that purpose might be a training in the appreciation of beauty, if, as I've argued, our love of beauty has a hundred million years of educational psychology behind it.

Let me finish then on a more positive note. Beauty may be an 'illusion'. But, for all that, Keats was not so wrong in his claim that "beauty is truth, truth beauty". That may not be "all ye know on Earth, and all ye need to know", but it is at least a good beginning.

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