

don't eat their seed corn; they bury it in the ground and wait months for a return. They don't eat the compost with which they fertilise the soil and don't drink the water with which they irrigate it. Again, it is all done for a delayed reward. And the leaf cutter ant got there first. Consider her ways and be wise.

The Grasshopper's Tale

The Grasshopper's Tale treats of the vexed and sensitive topic of race.

There is a pair of European grasshopper species, *Chorthippus brunneus* and *C. biguttulus*, which are so similar that even expert entomologists can't tell them apart, yet they never cross-breed in the wild although they sometimes meet. This defines them to be 'good species'. But experiments have shown that you need only allow a female to hear the mating call of a male of her own species caged nearby and she will happily mate with a male of the wrong species, 'thinking', one is tempted to say, that he is the singer. When this happens, healthy and fertile hybrids are produced. It doesn't normally happen in the wild because a female doesn't normally find herself near, but unable to reach, a singing male of her own species at the same time as a male of the wrong species is courting her.

Comparable experiments have been done on crickets, using temperature as an experimental variable. Different species of cricket chirp at different frequencies, but the chirp frequency is also temperature-dependent. If you know your crickets, you can use them as a reasonably accurate thermometer. Fortunately, not only the male's chirping frequency but also the female's perception of it is temperature-dependent: the two vary in lockstep, which normally precludes miscegenation. A female in an experiment, offered a choice of males singing at two different temperatures, chooses the one at her own temperature. The male singing at a different temperature is treated as if he belongs to the wrong species. If you heat up a female, her preference shifts to a 'hotter' song, even if that causes her to prefer a cool male of the wrong species. Once again, this normally doesn't happen in nature. If a female can hear a male at all, he can't be far away, and so is likely to be at approximately the same temperature as she is.

Grasshopper song is temperature-dependent in the same kind of way. Using grasshoppers of the same genus, *Chorthippus*, with which we began (though different species of the genus), German scientists did some technically ingenious experiments. They managed to attach tiny thermometers (thermocouples) and tiny electric heaters to the insects. So miniaturised were these, the experimenters could heat the head of a grasshopper without heating its thorax, or heat the thorax without heating the head. Then they tested females' preferences for songs produced by males stridulating at various temperatures.* They found that what matters for the female song preference is the temperature of the head. But it is the temperature of the thorax that determines the stridulation rate. Fortunately of course, in nature, where there are no experimenters with tiny electric heaters, the head and thorax will normally be at the

Stridulation is how grasshoppers, and crickets, make sound. Grasshoppers scrape their legs against their wing covers. Crickets scrape the two wing covers against each other. They sound similar, but grasshoppers are generally more buzzy, crickets more musical. Of one nocturnal tree cricket it has been said that if moonlight could be heard, that is how it would sound. Cicadas are quite different. As if buckling a tin lid, they buckle part of the thorax wall, repeatedly and fast, so it sounds like a continuous buzz, usually extremely loud and sometimes patterned in very complex ways, characteristic of the species.

same temperature, as will the male and the female. So the system works, and hybridisation doesn't happen.

It is quite common to find pairs of related species that never interbreed under natural conditions but that can do so if humans interfere. The case of *Chorthippus brunneus* and *C. biguttulus* is just one example. The Cichlid's Tale told of a comparable case in fish, where monochromatic light abolished the discrimination between a reddish and a bluish species. And it happens in zoos. Biologists normally classify animals that mate under artificial conditions but refuse to mate in the wild as separate species, as has happened with the grasshoppers. But unlike, say, lions and tigers, which can hybridise in zoos to make (sterile) 'ligers' and 'tigrons', those grasshoppers look identical. Apparently the only difference is in their songs. And it is this, and only this, that stops them cross-breeding and therefore leads us to recognise them as separate species. Human beings are the other way round. It requires an almost superhuman feat of political zeal to overlook the conspicuous differences between our own local populations or races. Yet we happily interbreed across races and are unequivocally and uncontroversially defined as members of the same species. The Grasshopper's Tale is about races and species, about the difficulties of defining both, and what all this has to say about human races.

'Race' is not a clearly denned word. 'Species', as we have seen, is different. There really is an agreed way to decide whether two animals belong in the same species: can they interbreed? Obviously they can't if they are of the same sex, or are too young or too old, or one of them happens to be sterile. But those are pedantries, easy to get around. In the case of fossils, too, which obviously can't breed, we apply the interbreeding criterion in our imaginations. Do we think it *likely* that, if these two animals were not fossils but alive, fertile and of opposite sex, they would be able to interbreed?

The interbreeding criterion gives the species a unique status in the hierarchy of taxonomic levels. Above the species level, a genus is just a group of species that are pretty similar to each other. No objective criterion exists to decide *how* similar they have to be, and the same is true of all the higher levels: family, order, class, phylum and the various 'sub-' or 'super-' names that intervene between them. Below the species level, 'race' and 'subspecies' are used more or less interchangeably and, again, no objective criterion exists that would enable us to decide whether two people should be considered part of the same race or not, nor to decide how many races there are. And of course there is the added complication, absent above the species level, that races interbreed, so there are lots of people of mixed race.

Presumably species, on their way to becoming sufficiently separate to be incapable of interbreeding, usually pass through an intermediate stage of being separate races. Separate races might be regarded as species in the making, except that there is no necessary expectation that the making will continue to its end — to speciation.

The interbreeding criterion works pretty well, and it delivers an unequivocal verdict on humans and their supposed races. All living human races interbreed with one another. We are all members of the same species, and no reputable

biologist would say any different. But let me call your attention to an interesting, perhaps even slightly disturbing fact. While we happily interbreed with each other, producing a continuous spectrum of inter-races, we are strangely reluctant to give up our divisive racial language. Wouldn't you expect that if all intermediates are on constant display, the urge to classify people as one or the other of two extremes would wither away, smothered by the absurdity of the attempt, which is continually manifested everywhere we look? Unfortunately, this is not what happens, and perhaps that very fact is revealing.

People who are universally agreed by all Americans to be 'black' may draw less than one-eighth of their ancestry from Africa, and often have a light skin colour well within the normal range for people universally agreed to be 'white'. In this picture of four American politicians, two are described in all newspapers as black: the other two as white. Wouldn't a Martian, unschooled in our conventions but able to see skin shades, be more likely to split them three against one? Surely yes. But in our culture, almost everybody will immediately 'see' Mr Powell as 'black', even in this particular photograph which happens to show him with possibly lighter skin than either Bush or Rumsfeld.

It is an interesting exercise to take a colour photograph, such as this one, of Colin Powell standing next to some representative 'white' men (they must be next to each other so the lighting conditions are the same). From each face, cut a small uniform rectangle, say from the forehead, and place the patches side by side. You will find that there is very little difference between Powell and the 'white' men with whom he is standing. He may be lighter or darker, depending upon the particular cases. But now 'zoom out' and look again at the original photograph. Immediately, Powell will look 'black'. What cues are we picking up on?

To ram home the point, do the same 'forehead patch' exercise with Powell standing next to a genuinely black man such as Daniel Arap Moi, the recent President of Kenya (see next page). This time, the forehead patches will look dramatically different. But then, when we 'zoom out' and look at the whole faces, we again 'see' Mr Powell as 'black'. The news story that accompanied this picture of Powell, visiting Moi in May 2001, implied that the same conventions are understood in Africa:

Why do people so readily swallow the apparent contradiction — and there are numerous similar examples — between the verbal statement, 'he is black', and the picture it accompanies. What is going on here? Various things. First, we are curiously eager to embrace racial classification, even when talking about individuals whose mixed parentage seems to make a nonsense of it, and even where (as here) it is irrelevant to anything that matters.

Second, we tend not to describe people as of mixed race. Instead, we plump for one race or the other. Some American citizens are of pure African descent and some are of pure European descent (leaving aside the fact that, in the longer term, we are all of African descent). Maybe it is convenient for some purposes to call them black and white respectively, and I am not proposing any principled objection to these names. But many people — probably more than most of us realise — have both black and white ancestors. If we are going to use colour terminology, many of us are presumably somewhere in between. Yet society insists on calling us one or the other. It is an example of the 'tyranny of the discontinuous mind', which was the subject of the Salamander's Tale. Americans are regularly asked to fill in forms in which they have to tick one of five boxes: Caucasian (whatever that might mean — it certainly doesn't mean from the Caucasus), African-American, Hispanic (whatever that might mean — it certainly does not mean, as the word seems to suggest, Spanish), Native American or Other. There are no boxes labelled half and half. But the very idea of ticking boxes is incompatible with the truth, which is that many, if not most, people are a complicated mixture of the offered categories and others. My inclination is irritably to refuse to tick any boxes, or to add my own box labelled 'human'. Especially when the rubric uses the mealy-mouthed euphemism 'Ethnicity'.

Third, in the particular case of 'African-Americans', there is something culturally equivalent to genetic dominance in our use of language. When Mendel crossed wrinkled peas with smooth peas, all the first generation progeny were smooth. Smooth is 'dominant', wrinkled is 'recessive'. The first generation progeny all had one smooth allele and one wrinkled, yet the peas themselves were indistinguishable from peas with no wrinkled genes. When an Englishman marries an African, the progeny are intermediate in colour and in most other characteristics. This is unlike the situation in peas. But we all know how society will call such children: "black" every time. Blackness is not a true genetic dominant like smoothness in peas. But social *perception* of blackness behaves

like a dominant. It is a cultural or memetic dominant. That insightful anthropologist Lionel Tiger has attributed this to a racist 'contamination metaphor' within white culture. And no doubt there is also a strong and understandable will on the part of descendants of slaves to identify with their African roots. I have already remarked on this in *Eve's Tale* — regarding the television documentary where Jamaican immigrants to Britain were emotionally reunited with alleged 'family' in West Africa.

Fourth, there is high inter-observer agreement in our racial categorisations. A man such as Colin Powell, of mixed race and intermediate physical characteristics, is not described as white by some observers and black by others. A small minority will describe him as mixed. All others will without fail describe Mr Powell as black — and the same goes for anybody who shows the *slightest trace* of African ancestry, even if their percentage of European ancestors is overwhelming. Nobody describes Colin Powell as white, unless they are trying to make a political point by the very fact that the word jars against the audience's expectations.

There is a useful technique called 'inter-observer correlation'. It is a measure that is often used in science to establish that there really is a reliable basis for a judgement, even if nobody can pin down what that basis is. The rationale, in the present case, is this. We may not know how people decide whether somebody is 'black' or 'white' (and I hope I have just demonstrated that it isn't because they are black or white!) but there must be *some* sort of reliable criterion lurking there because any two randomly chosen judges will come to the same decision.

The fact that the inter-observer correlation remains high, even over a huge spectrum of inter-races, is impressive testimony to something fairly deep-seated in human psychology. If it holds up cross-culturally, it will be reminiscent of the anthropologists' finding about perception of hue. Physicists tell us that the rainbow, from red through orange, yellow, green and blue to violet is a simple continuum of wavelength. It is biology and/or psychology, not physics, that singles out particular landmark wavelengths along the physical spectrum for special treatment and naming. Blue has a name. Green has a name. Blue-green does not. The interesting finding of anthropologists' experiments (as opposed to some influential anthropological theories, by the way) is that there is substantial agreement over such namings across different cultures. We seem to have the same kind of agreement over judgements of race. It may prove to be even stronger and clearer than for the rainbow.

As I said, zoologists define a species as a group whose members breed with each other under natural conditions — in the wild. It doesn't count if they breed only in zoos, or if we have to use artificial insemination, or if we fool female grasshoppers with caged singing males, even if the offspring produced are fertile. We might dispute whether this is the only sensible definition of a species, but it is the definition that most biologists use.

If we wished to apply this definition to humans, however, there is a peculiar difficulty: how do we distinguish natural from artificial conditions for interbreeding? It is not an easy question to answer. Today, all surviving humans are firmly placed in the same species, and they do indeed happily interbreed. But

the criterion, remember, is whether they choose to do so under natural conditions. What are natural conditions for humans? Do they even exist any more? If, in ancestral times, as sometimes today, two neighbouring tribes had different religions, different languages, different dietary customs, different cultural traditions and were continually at war with one another; if the members of each tribe were brought up to believe that the other tribe were subhuman 'animals' (as happens even today); if their religions taught that would-be sexual partners from the other tribe were taboo, 'shiksas', or unclean, there could well be no interbreeding between them. Yet anatomically, and genetically, they could be completely the same as each other. And it would take only a change of religious or other customs to break down the barriers to interbreeding. How, then, might somebody try to apply the interbreeding criterion to humans? If *Chorthippus brunneus* and *C. biguttulus* are separated as two distinct species of grasshoppers because they prefer not to interbreed although they physically could, might humans, at least in ancient times of tribal exclusivity, once have been separable in the same kind of way? *Chorthippus brunneus* and *C. biguttulus*, remember, in all detectable respects except their song, are identical, and when they are (easily) persuaded to hybridise their offspring are fully fertile.

Whatever we may think as observers of superficial appearances, the human species today is, to a geneticist, especially uniform. Taking such genetic variation as the human population does possess, we can measure the fraction that is associated with the regional groupings that we call races. And it turns out to be a small percentage of the total: between 6 and 15 per cent depending on how you measure it — much smaller than in many other species where races have been distinguished. Geneticists conclude, therefore, that race is not a very important aspect of a person. There are other ways to say this. If all humans were wiped out except for one local race, the great majority of the genetic variation in the human species would be preserved. This is not intuitively obvious and may be quite surprising to some people. If racial statements were as informative as most Victorians, for example, used to think, you would surely need to preserve a good spread of all the different races in order to preserve most of the variation in the human species. Yet this is not the case.

It certainly would have surprised Victorian biologists who, with few exceptions, saw humanity through race-tinted spectacles. Their attitudes persisted into the twentieth century. Hitler was unusual in gaining the power to turn racist ideas into government policy. Plenty of others, not just in Germany, had the same thoughts but lacked the power. I have previously quoted H. G. Wells's vision of his New Republic (*Anticipations*, 1902), and I do so again because it is such a salutary reminder of how a leading British intellectual, regarded in his time as progressive and left-leaning, could say such horrifying things, only a century ago, and scarcely be noticed doing so.

And how will the New Republic treat the inferior races? How will it deal with the black?... the yellow man?... the Jew?.. those swarms of black, and brown, and dirty-white, and yellow people, who do not come into the new needs of efficiency? Well, the world is a world, and not a charitable institution, and I take it they will have to go... And the ethical system of these men of the New Republic, the

ethical system which will dominate the world state, will be shaped primarily to favour the procreation of what is fine and efficient and beautiful in humanity — beautiful and strong bodies, clear and powerful minds... And the method that nature has followed hitherto in the shaping of the world, whereby weakness was prevented from propagating weakness... is death... The men of the New Republic... will have an ideal that will make the killing worth the while.'

I suppose we should take comfort from the change that has come over our attitudes during the intervening century. Perhaps, in a negative sense, Hitler can take some credit for this, since nobody wants to be caught saying anything that he said. But what, I wonder, will our successors of the twenty-second century be quoting, in horror, from us? Something to do with our treatment of other species, perhaps?

But that was an aside. We were dealing with the unusually high level of genetic uniformity in the human species, despite superficial appearances. If you take blood and compare protein molecules, or if you sequence genes themselves, you will find that there is less difference between any two humans living anywhere in the world than there is between two African chimpanzees. We can explain this human uniformity by guessing that our ancestors, but not the chimpanzees', passed through a genetic bottleneck not very long ago. The population was reduced to a small number, came close to going extinct, but just pulled through.* Like the children of Noah in the myth, we are all descended from this small population, and that is why we are so genetically uniform. Similar evidence, of even greater genetic uniformity, suggests that cheetahs passed through an even narrower bottleneck more recently, around the end of the last Ice Age.

Some people may find the evidence of biochemical genetics unsatisfying because it seems not to square with their everyday experience. Unlike cheetahs, we don't 'look' uniform.¹ Norwegians, Japanese and Zulus really do look rather dramatically different from one another. With the best will in the world, it is intuitively hard to believe what is in fact the truth: that they are 'really' more alike than three chimpanzees who look, to our eyes, much more similar.

This is, of course, a politically sensitive matter, a point I heard being amusingly lampooned by a West African medical researcher at a gathering of about 20 scientists. At the beginning of the conference, the chairman asked each of us around the table to introduce ourselves. The African, who was the only black person there — and he really was black, unlike many 'African-Americans' — happened to be wearing a red tie. He finished his self-introduction by laughingly saying, 'You can easily remember me. I am the one with the red tie.' He was genially mocking the way people bend over backwards to pretend not to notice racial differences. I think there was a *Monty Python* sketch along the same lines. Nevertheless, we can't write off the genetic evidence which suggests that, all appearances to the contrary, we really are an unusually uniform species. What is the resolution to the apparent conflict between appearance and measured reality?

It is genuinely true that, if you measure the total variation in the human species and then partition it into a between-race component and a within-race

¹ There is evidence of a fierce bottleneck — perhaps down to a population of 15,000, some 70,000 years ago, caused by a six-year 'volcanic winter' followed by a thousand-year ice age.

^t As an aside, leopards don't either. But black panthers', once thought to be a separate species, differ from spotted leopards at a single genetic locus.

component, the between-race component is a very small fraction of the total. Most of the variation among humans can be found within races as well as between them. Only a small admixture of extra variation distinguishes races from each other. That is all correct. What is not correct is the inference that race is therefore a meaningless concept. This point has been clearly made by the distinguished Cambridge geneticist A. W. F. Edwards in a recent paper called 'Human genetic diversity: Lewontin's fallacy'. R. C. Lewontin is an equally distinguished Cambridge (Mass.) geneticist, known for the strength of his political convictions and his weakness for dragging them into science at every possible opportunity. Lewontin's view of race has become near-universal orthodoxy in scientific circles. He wrote, in a famous paper of 1972:

It is clear that our perception of relatively large differences between human races and subgroups, as compared to the variation within these groups, is indeed a biased perception and that, based on randomly chosen genetic differences, human races and populations are remarkably similar to each other, with the largest part by far of human variation being accounted for by the differences between individuals.

This is, of course, exactly the point I accepted above, not surprisingly since what I wrote was largely based on Lewontin. But see how Lewontin goes on:

Human racial classification is of no social value and is positively destructive of social and human relations. Since such racial classification is now seen to be of virtually no genetic or taxonomic significance either, no justification can be offered for its continuance.

We can all happily agree that human racial classification is of no social value and is positively destructive of social and human relations. That is one reason why I object to ticking boxes in forms and why I object to positive discrimination in job selection. But that doesn't mean that race is of 'virtually no genetic or taxonomic significance'. This is Edwards's point, and he reasons as follows. However small the racial partition of the total variation may be, if such racial characteristics as there are are highly correlated with other racial characteristics, they are by definition informative, and therefore of taxonomic significance.

Informative means something quite precise. An informative statement is one that tells you something you didn't know before. The information content of a statement is measured as reduction in prior uncertainty. Reduction in prior uncertainty, in turn, is measured as a change in probabilities. This provides a way to make the information content of a message mathematically precise, but we don't need to bother with that.* If I tell you Evelyn is male, you immediately know a whole lot of things about him. Your prior uncertainty about the shape of his genitals is reduced (though not obliterated). You now know facts you didn't know before about his chromosomes, his hormones and other aspects of his biochemistry, and there is a quantitative reduction in your prior uncertainty about the depth of his voice, and the distribution of his facial hair and of his body fat and musculature. Contrary to Victorian prejudices, your prior un-

As it happens, Lewontin himself was one of the first biologists to use information theory, and indeed he did so in his paper on race, but for a different purpose. He used it as a convenient statistic for measuring diversity.

certainty about Evelyn's general intelligence, or ability to learn, remains unchanged by the news about his sex. Your prior uncertainty about his ability to lift weights or excel at most sports is quantitatively reduced, but only quantitatively. Plenty of females can beat plenty of males at any sport, although the best males can normally beat the best females. Your ability to bet on Evelyn's running speed, say, or the power of his tennis serve, has been slightly raised by my telling you his sex, but it has not reached certainty.

Now to the question of race. What if I tell you Suzy is Chinese, how much is your prior uncertainty reduced? You now are pretty certain that her hair is straight and black (or was black), that her eyes have an epicanthic fold, and one or two other things about her. If I tell you Colin is 'black' this does not, as we have seen, tell you he is black. Nevertheless, it is clearly not uninformative. The high inter-observer correlation suggests that there is a constellation of characteristics that most people recognise, such that the statement 'Colin is black' really does reduce prior uncertainty about Colin. It works the other way around to some extent. If I tell you Carl is an Olympic sprinting champion, your prior uncertainty about his 'race' is, as a matter of statistical fact, reduced. Indeed, you can have a fairly confident bet that he is 'black'.*

We got into this discussion through wondering whether the concept of race was, or had ever been, an information-rich way to classify people. How might we apply the criterion of inter-observer correlation to judging the question? Well, suppose we took standard full-face photographs of 20 randomly chosen natives of each of the following countries: Japan, Uganda, Iceland, Sri Lanka, Papua New Guinea and Egypt. If we presented all 120 people with all 120 photographs, my guess is that every single one of them would achieve 100 per cent success rates in sorting them into six different categories. What is more, if we told them the names of the six countries involved, all 120 subjects, if they were reasonably well educated, would correctly assign all 120 photographs to the correct countries. I haven't done the experiment but I am confident that you will agree with me on what the result would be. It may seem unscientific of me not to bother to do the experiment. But my confidence that you, being human, will agree without doing the experiment, is the very point I am trying to make.

If the experiment were to be done, I do not think Lewontin would expect any other result than the one I have predicted. Yet an opposite prediction would seem to follow from his statement that racial classification has virtually no taxonomic or genetic significance. If there is no taxonomic or genetic significance, the only other way to get a high inter-observer correlation would be a worldwide similarity in cultural bias, and I do not think Lewontin would want to predict that either. In short, I think Edwards is right and Lewontin, not for the first time, wrong. Lewontin did his sums right, of course: he is a brilliant mathematical geneticist. The proportion of the total variation in the human species that falls into the racial partition of variation is, indeed, low. But because the between-race variation, however low a percentage of the total variation, is *correlated*, it is informative in ways that could surely be demonstrated by measuring the inter-observer concordance of judgement.

I must at this point reiterate my strong objection to being asked to fill in

Sir Roger Bannister got into terrible hot water, for no good reason that I could discern except people's hair-trigger sensitivities on matters of race, when he said something similar a few years ago.

forms in which I have to tick a box labelling my 'race' or 'ethnicity', and voice my strong support for Lewontin's statement that racial classification can be actively destructive of social and human relations — especially when people use racial classification as a way of treating people differently, whether through negative or positive discrimination. To tie a racial label to somebody is informative in the sense that it tells you more than one thing about them. It might reduce your uncertainty about the colour of their hair, the colour of their skin, the straightness of their hair, the shape of their eye, the shape of their nose and how tall they are. But there is no reason to suppose that it tells you anything about how well-qualified they are for a job. And even in the unlikely event that it did reduce your statistical uncertainty about their likely suitability for some particular job, it would *still* be wicked to use racial labels as a basis for discrimination when hiring somebody. Choose on the basis of ability, and if, having done so, you end up with an all-black sprinting team, so be it. You have not practised racial discrimination in arriving at this conclusion.

A great conductor, when auditioning instrumentalists for his orchestra, always had them perform behind a screen. They were told not to speak, and they even had to remove their shoes for fear the sound of high heels would betray the sex of the performer. Even if it were statistically the case that women tend to make better harpists, say, than men, this does *not* mean that you should actively discriminate against men when you choose a harpist. Discriminating against individuals purely on the basis of a group to which they belong is, I am inclined to think, always evil. There is near-universal agreement today that the apartheid laws of South Africa were evil. Positive discrimination in favour of 'minority' students on American campuses can fairly, in my opinion, be attacked on the same grounds as apartheid. Both treat people as representative of groups rather than as individuals in their own right. Positive discrimination is sometimes justified as redressing centuries of injustice. But how can it be just to pay back a single individual today for the wrongs done by long dead members of a plural group to which he belongs?

Interestingly, this kind of singular/plural confusion shows up in a form of words which is tellingly diagnostic of bigots: "The Jew..." instead of Jews ...'

Your Fuzzy Wuzzy is an excellent fighter, but he can't tell his left from his right.
Now, your Pathan ...

People are individuals, they are individually different, far more different from other members of their group than their groups are from each other. In this, Lewontin is undoubtedly right.

Inter-observer agreement suggests that racial classification is not totally uninformative, but what does it inform *about*? About no more than the characteristics used by the observers when they agree: things like eye shape and hair curliness — nothing more unless we are given further reasons to believe it. For some reason it seems to be the superficial, external, trivial characteristics that are correlated with race — perhaps especially facial characteristics. But why are human races so different in just these superficially conspicuous characteristics? Or is it just that we, as observers, are predisposed to notice them? Why do other

species look comparatively uniform whereas humans show differences that, if we encountered them elsewhere in the animal kingdom, might make us suspect we were dealing with a number of separate species?

The most politically acceptable explanation is that the members of any species have a heightened sensitivity to differences among their own kind. On this view, it is just that we *notice* human differences more readily than differences within other species. Chimpanzees whom we find almost identical look just as different, in chimpanzee eyes, as a Kikuyu is different from a Dutchman in our eyes. Expecting to confirm this kind of theory at the within-race level, the eminent American psychologist H. L. Teuber, an expert on the brain mechanisms of facial recognition, asked a Chinese graduate student to study the question, 'Why do Westerners think Chinese people look more alike than Westerners?' After three years intensive research, the Chinese student reported his conclusion. 'Chinese people really do look more alike than Westerners!' Teuber told the story with much twinkling and wiggling of eyebrows, a sure sign with him that a joke was on the way, so I don't know what the truth of the matter is. But I have no difficulty in believing it, and I certainly don't think it should upset anyone.

Our (relatively) recent worldwide diaspora out of Africa has taken us to an extraordinarily wide variety of habitats, climates and ways of life. It is plausible that the different conditions have exerted strong selection pressures, particularly on externally visible parts, such as the skin, which bear the brunt of the sun and the cold. It is hard to think of any other species that thrives so well from the tropics to the Arctic, from sea level to the high Andes, from parched deserts to dripping jungles, and through everything in between. Such different conditions would be bound to exert different natural selection pressures, and it would be positively surprising if local populations did not diverge as a result. Hunters in the deep forests of Africa, South America and South-East Asia have all independently become small, almost certainly because height is a handicap in dense vegetation. Peoples of high latitude, who, it has been surmised, need all the sun they can get to make vitamin D, tend to have lighter skins than those who face the opposite problem — the carcinogenic rays of the tropical sun. It is plausible that such regional selection would especially affect superficial characteristics like skin colour, while leaving most of the genome intact and uniform.

In theory, that could be the full explanation for our superficial and visible variety, covering deep similarity. But it doesn't seem enough to me. At the very least, I think it might be helped along by an additional suggestion, which I offer tentatively. It takes off from our earlier discussion about cultural barriers to interbreeding. We are indeed a very uniform species if you count the totality of genes, or if you take a truly random sample of genes; but perhaps there are special reasons for a disproportionate amount of variation in those very genes that make it easy for us to notice variation, and to distinguish our own kind from others. This would include the genes responsible for externally visible 'labels' like skin colour. Yet again, I want to suggest that this heightened discriminability has evolved by sexual selection, specifically in humans because we are such a culture-bound species. Because our mating decisions are so heavily

influenced by cultural tradition, and because our cultures, and sometimes our religions, encourage us to discriminate against outsiders, especially in choosing mates, those superficial differences that helped our ancestors to prefer insiders over outsiders have been enhanced out of all proportion to the real genetic differences between us. No less a thinker than Jared Diamond has supported a similar idea in *The Rise and Fall of the Third Oximpanzee*. And Darwin himself more generally invoked sexual selection in explanation of racial differences.

I want to consider two versions of this theory: a strong and a weak one. The truth could be any combination of the two. The strong theory suggests that skin colour, and other conspicuous genetic badges, evolved actively as discriminators in choosing mates. The weak theory, which can be thought of as leading into the strong version, places cultural differences, such as language and religion, in the same role as geographical separation in the incipient stages of speciation. Once cultural differences have achieved this initial separation, with the consequence that there is no gene flow to hold them together, the groups would subsequently evolve apart genetically, as if geographically separated.

Recall from the Cichlid's Tale that an ancestral population can split into two genetically distinct populations only if given a head start by an initial accidental separation, usually assumed to be geographical. A barrier such as a mountain range reduces gene flow between two populated valleys. So the gene pools in the two valleys are free to drift apart. The separation will normally be abetted by different selection pressures; one valley may be wetter than its neighbour on the other side of the mountains, for instance. But the initial accidental separation, which I have so far assumed to be geographical, is necessary.

Nobody is suggesting that there is anything deliberate about the geographical separation. That isn't what 'necessary' means at all. Necessary just means that, if there didn't happen to be an initial geographical (or equivalent) separation, the various parts of the population would be genetically bound together by sexual mixing between them. Speciation couldn't happen without an initial barrier. Once the two putative species, initially races, have begun to pull apart, genetically speaking, they may then pull even farther apart — even if the geographical barrier subsequently disappears.

There is controversy here. Some people think the initial separation has to be geographical, while others, especially entomologists, emphasise so-called sympatric speciation. Many herbivorous insects eat only one species of plant. They meet their mates and lay their eggs on the preferred plants. Their larvae then apparently 'imprint' on the plant that they grow up eating, and they choose, when adult, the same species of plant to lay their own eggs.* So if an adult female made a mistake and laid her eggs on the wrong species of plant, her daughter would imprint on that wrong plant and would, when the time came, lay her eggs on plants of the same wrong species. Her larvae then would imprint on the same wrong plant, hang around the wrong plant when adult, mate with others hanging around the wrong plant and eventually lay their eggs on the wrong plant.

In the case of these insects, you can see that, in a single generation, gene flow with the parental type could be abruptly cut off. A new species is theoretically

Imprinting is the process, often said to have been discovered by Konrad Lorenz, whereby young animals, for instance goslings, take a kind of mental photograph of an object they see during a critical period early in life, and which they follow while young. Usually it will be a parent, but it could be Konrad Lorenz's boots. Later in life, the "mental photograph" influences choice of mate: this usually means a member of their own species, but they might try to mate with Lorenz's boots. The gosling story isn't as simple as that, but the analogy to the insect case should be clear.

free to come into being without the need for geographical isolation. Or — another way of putting it — the difference between two kinds of food plant is, for these insects, equivalent to a mountain range or a river for other animals. It has been argued that this kind of sympatric speciation is commoner among insects than 'true' geographical speciation, in which case, since the majority of species are insects, it could even be that most speciation events are sympatric. Be that as it may, I am suggesting that human culture provides a special way in which gene flow can find itself blocked, which is somewhat analogous to the insect scenario I have just outlined.

In the insect case, plant preferences are handed down from parent to offspring by the twin circumstances of larvae fixating on their food plant, and adults mating and laying eggs on the same food plants. In effect, lineages establish 'traditions' that travel longitudinally down generations. Human traditions are similar, if more elaborate. Examples are languages, religions and social manners or conventions. Children usually adopt the language and the religion of their parents although, just as with the insects and the food plants, there are enough 'mistakes' to make life interesting. Again, as with the insects mating in the vicinity of their preferred food plants, people tend to mate with others speaking the same language and praying to the same gods. So different languages and religions can play the role of food plants, or of mountain ranges in traditional geographical speciation. Different languages, religions and social customs can serve as barriers to gene flow. From here, according to the weak form of our theory, random genetic differences simply accumulate on opposite sides of a language or religion barrier, just as they might on opposite sides of a mountain range. Subsequently, according to the strong version of the theory, the genetic differences that build up are reinforced as people use conspicuous differences in appearance as additional labels of discrimination in mate choice, supplementing the cultural barriers that provided the original separation.*

I am certainly not suggesting that humans should be thought of as more than one species. Very much the contrary. What I am suggesting is that human culture — the fact that we depart so strongly from random mating in directions determined by language, religion and other cultural discriminators, has done very odd things to our genetics in the past. Even though, if you take the totality of genes into account, we are a very uniform species, we are astonishingly variable in superficial features which are trivial but conspicuous: discrimination fodder. The discrimination might apply not just to mate choice but to choice of enemies and victims of xenophobic or religious prejudice.

" A potential problem, which would need sorting out if the idea were to be pursued, is that the theory of mathematical genetics suggests, for geographical separation and by implication this cultural hypothesis too, that the separation has to be pretty complete for genetic differentiation to be maintained.

The Fruit Fly's Tale

In 1894 the pioneering geneticist William Bateson published a book called *Materials for the Study of Variation, Treated with Especial Regard to Discontinuity in the Origin of Species*. He compiled a fascinating, almost macabre list of genetic