
Opening Extract from...

The Scots:
A Genetic Journey

Written by
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A GENETIC JOURNEY

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To my friend Francis Hamilton – a man who knows what's what and who's who

Alistair Moffat

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The Crowd

EVERY YEAR, IN THE dowie days of February and early March, Scotland comes to Edinburgh. From the platforms of Waverley and Haymarket Stations, from buses parked at King's Stables Road, from cars left in the western suburbs, an army musters. The yellow of the Lion Rampant and the blue of the Saltire standards flutter as tens of thousands march west out of the centre of the city, flooding like a tartan tide along Shandwick Place, West Maitland Street, past Donaldson's Hospital to Roseburn and the old battleground.

To join the national muster Northerners come down on the morning trains from Inverness and Aberdeen. From the west, Argyll, Ayrshire and Glasgow, they rattle through in commuter carriages or join the high-speed queue that is the M8. From the Borders, once the heartland, they arrive in their thousands. It is the journey of an army of hope that often ends in despairing, rancorous retreat. It is Scotland playing rugby at Murrayfield.

The sea of expectant faces, 67,000 strong, most of them gasping with exasperation or shouting encouragement to the team wearing navy blue, knows that Scotland can beat any team in the world, except New Zealand, and can lose to any team in the world. But they glory in their day and its lurching swings of emotion, the crowd a counterpoint to the play on the pitch. All

follow the unscripted drama, pause for breath at stoppages, roar at breaks and thrusts, groan at breakdowns and mistakes. For an afternoon, Scotland, Scottishness and being Scots behave like an organism, like an unwitting microcosm of a nation.

In many important ways, the Murrayfield crowd is just that. Allowing for the supporters of visiting teams, it represents 1 per cent of the population. The stands are filled with men, women and children from the Highlands, Aberdeenshire and Tayside, Perthshire and Fife, from the Clyde coastlands, from Galloway and the Borders and the cities of Scotland. The days of a male-dominated rugby crowd are long gone now and, while women may not make up 50 per cent, the proportion is large.

What superficially binds and identifies the crowd are their iconography and a sense of shared history. Kilts, flags worn as capes, face paints, See-You-Jimmy hats and national rugby jerseys are part of the carnival uniform. And, when Scotland needs slightly different sorts of exhortation, the team is advised to 'Remember Bannockburn' or, alternatively, 'Remember Flodden'. Before hostilities begin, 'Flower of Scotland' is sung to a dirge-like tune. The anthem recalls the triumph at Bannockburn as though it were a matter for mourning. Proud Edward's army is defeated and, in an unlikely anachronism, Robert the Bruce is said to have 'sent him homeward tae think again'.

Kings and battles, flags and tartan – these appear to be the stuff of history for the crowd. A procession of armies across Scotland's landscape, the drama of warfare and raid, picturesque ruins, important dates are all lines in a familiar recital. Until the nineteenth century, the story of Scotland circled around the doings and decisions of elites, of tiny groups of powerful and interconnected people. Monarchs, aristocrats and churchmen actually *made* history or at least had control over its recording. Over most of the vast span of all that experience in what is now Scotland, there was simply no place for the stories of ordinary lives, of the agricultural labourers whose back-breaking toil formed the landscape, the tradesmen whose skills made the work easier and the masons who built the great churches, castles and grand houses.

The Murrayfield crowd cannot know anything about these unrecounted generations except for one simple thing – that they were their ancestors. And that irreducible fact is the rock upon which this book and all the research behind it is built. As the tramp of invading armies echoes and fades and in the long shadows behind the stately line of kings and noblemen and their stately homes, we may now at last be able to make out the modest outline of a people's history of Scotland – our people, ourselves, our history, a story of Scotland we can all own. The Murrayfield crowd hold it inside themselves – a long-hidden story of unlikely and unsurprising links, a story that reaches back beyond kings and queens to the very beginnings of settlement in Scotland after the end of the last Ice Age, a story that is more than 11,000 years old. It is the story of our DNA.

Every Scot is an immigrant. Until 9,000 BC, Scotland was empty of people and animals. For 15,000 years, ice, more than a kilometre thick in places, had crushed the land under a pitiless white sterility where nothing could live. When the ice sheets finally retreated, small bands of pioneers moved north into a virgin landscape. Their names are not known but scientists have been able to discover a great deal about where they came from. Immigrants arrived in what would become Scotland over thousands of years, well into the historical period. And their descendants are still here, flourishing, carrying on the long journey of their genes. By approximately AD 1000, the process was almost complete and most of the pieces of our patchwork of DNA were in place. Significant but small groups did come to Scotland after 1000 but, in statistical terms, their impact was minimal.

That is why the balance of this book is heavily tilted towards prehistoric and early historic times. DNA research works best in a chronological context and that is the reason for the first landmarks in our history being clearly plotted in this story – although some of these turn out to be misleading.

Language and its development are closely linked to who we are and where we came from and the evolution of Old Welsh, Scots English and Gaelic is an important theme. There exist fascinating linguistic links and many of them were forged in deep time, tens

of thousands of years ago as our ancestors crossed seas and rivers to walk into empty landscapes and populate the Earth.

As well as Y chromosomes, men inherit surnames and, as these came increasingly into common use in the early modern period, they help set genetic findings against a familiar background. For example, Scotland's Highland clans often claim descent from a common name-father but recent research shows that some of these men may have been fathers in more than name only.

None of what follows would have been possible without the pioneering work of two scientists working in the universities of California. In the 1960s, Professor Luca Cavalli-Sforza was the first to apply genetics to history and he used the first DNA markers to do this. These were the familiar blood groups – ABO, rhesus and so on. Earlier research had shown that these differed between populations across the world and, using these findings, Cavalli-Sforza built a version of a family tree that showed how populations were related to each other. What puzzled him and others was the deep differences between populations in Africa.

A New Zealander of Scots descent, Professor Allan Wilson, began to study mitochondrial DNA, what women pass on through the female line to their daughters and to their sons (but it dies with them). He saw how individuals, and not just populations, were related to each other through their DNA. And, because these branches of connection were longest in Africa, Wilson and his team made the earth-shattering announcement that the human race had originated there.

This caused uproar. Most scientists believed that Homo sapiens had descended from various ancestors around the world – the Chinese were thought to be the children of Peking Man, the South-East Asians came from Java Man and Europeans from Neanderthals. The discovery that modern humans had walked out of Africa to populate the whole of the rest of the world was sensational and it made headlines. Images of a real Garden of Eden suddenly came into focus and Mitochondrial Eve was pictured on the cover of *Time Magazine*.

Research began to gather pace. After a period of emphasis on

mitochondrial DNA, Y chromosome evidence was analysed and hundreds of new markers identified in the 1990s. Dating techniques improved and some European lineages were shown to originate before the last Ice Age, while others had been brought into Europe by early farmers from the Middle East.

At the same time, analysing DNA samples became simpler, faster and cheaper. All individuals had to do was to spit into a plastic capsule (a 'kissing spit' is advised as being sufficient and a hawking spit is to be avoided – for all sorts of reasons), seal it and send it off to be processed. Very quickly, there were companies that, for a fee, would test DNA and explain it and the results were uploaded to a series of databases. Worldwide there are probably around 200,000 results for Y chromosome tests and in Britain about 20,000. These come from people anxious to trace their family trees. They are large and reliable samples and they are being constantly augmented and refined. Once a geneticist has the results of a DNA test, he looks at the database for other markers of the same sort. Many of these have locations or origins attached and also other important genealogical information. This allows a context for new samples and makes all sorts of fascinating links, both geographical and historical.

One of the most striking findings in this flurry of recent research is the story of the epic journey of our ancestors out of Africa. Whoever the Scots believe themselves to be now, they are descended from Africans. The same is true for the English, the Irish, the Russians, the Chinese – all of the rest of the peoples of the world. It is a wonderfully refreshing, ironic and redressing balance for centuries of racial prejudice to think that Homo sapiens, and not-so-sapiens, originated amongst people once routinely and widely believed to be sub-human. Instead, it is clear that Africans were once our mothers and fathers.

At the other end of the chronology of DNA history, my own experience as a child touched on the insistent theme of this book, that of immigration. At school in Kelso I sat next to Richard Mazur and Jot Wichary. I knew Denis and Brian Poloczek and Harry Tomczek, and admired Leona Goldsztajn from, sadly, a distance. Their DNA and that of the children of other Polish

exiles arrived in Scotland because of an accident of history and, as a further consequence of happenstance, was concentrated in Kelso. It now enriches Scotland and makes only one of thousands of links in the chain of stories that follows.

Alistair Moffat
St Andrew's Day, 2010

I

The Refuges

At the tips of its wingspread, the eagle's feathers fluttered in the warm updraft. Stalling and banking in the breeze, it suddenly, effortlessly soared high over the sunlit Clyde Valley. Through the clear air, the great bird flicked its head from side to side, looking down on an endless vista of rolling green grasslands watered by the river and its tributaries. Glinting in the sun, hundreds of small pools patterned the open landscape.

Its attention caught by sudden movement, the eagle turned and spiralled downward to where three pools clustered. Their surfaces quivered as thunder stampeded past their shores. Trumpeting, their tusks swaying, a herd of mammoths crashed through the grassland, fleeing headlong from danger. Behind them cave lions had brought down a calf and, as the dying animal thrashed, hooked tusks slashing in the air, its killers dug their incisors into its throat, choking out the life. The eagle could see that there would be no pickings later for a pack of hyenas was circling, waiting for the lions to be gorged and sated.

Elsewhere on the treeless plains, other prey grazed. Vast herds of wild horses ranged over wide pasture. With their lookout stallions skirting the fringes of the herds and the dominant mares keeping them together, the small horses could be difficult to bring down. Fast and wary, they could see or sniff trouble before it was upon them. But, when mares broke off to drop their foals, usually at the dead of night, packs of wolves could pick them off.

In the morning, there would be something left for a sharp-eyed eagle.

Few predators were bold enough to take on the hard-charging woolly rhinoceros and the brown bears, bigger than grizzlies, that roamed the uplands. Through its long life in the skies above the grasslands the eagle had seen only one predator with the guile, strength and determination to attack any animal, no matter how fast, large or ferocious.

Three thousand generations ago, some time around 58,000 BC, men and women walked north into Britain. At that time, it was the far north-western peninsula of the European landmass. So much ice had formed around the poles and over Scandinavia that the level of the sea had fallen between 160 and 260 feet below modern norms. The weather was cold all year round but dry and few trees grew on the peninsula. But the rich summer grasslands drew herd animals northwards and behind the reindeer, the wild horses and the thundering herds of mammoths came small bands of hunters. They were human beings but they were not like us.

In 1856, near Dusseldorf in Germany, miners were quarrying a limestone canyon when they opened out a cave mouth. Inside lay a scatter of bones, parts of a skull, arm and leg bones and ribs. They were very thick and, at first, the miners believed they had come across the skeleton of a cave bear. When an amateur naturalist, Johann Carl Fuhlrott, and an anatomist, Hermann Schaaffhausen, saw the bones they realised immediately that they could only be human but not because they were exactly like those of our subspecies, Homo sapiens. Since the remains were found in a cave in the valley of the Neander River, they named their discovery Neanderthal Man.

Skeletal remains found all over Europe have allowed a clear picture of the Neanderthals to be pieced together. With deep barrel chests, stout bones and tremendous musculature, their stooped bodies were well adapted to cold climates. A reduced surface area prevented heat loss and it seems likely that their bodies were comparatively hairy. Neanderthal skulls show a massive brow ridge, a receding chin with prominent cheekbones and a larger brain case than Homo sapiens. Scientists believe that

their big brains may have enabled greatly enhanced night vision, a valuable attribute for a society based almost exclusively on hunting and gathering.

Neanderthal noses were large and flat, able to inhale and exhale a greater capacity. It used to be thought that this was another feature of a cold-adapted physique with a bigger nose warming freezing air a little to prevent it shocking the lungs. But recent research promotes a more likely and more elegant thesis. For very stocky bodies, exertion and a consequent rise in temperature could be difficult and it may well be that the Neanderthals' noses acted as efficient heat exchangers helping them cool down quickly.

For skilled scientists, skeletons can be eloquent, offering a sure guide to living musculature, and it is possible to reconstruct accurately not only what these men and women looked like but also how they used their bodies. Their powerful build speaks of a life of tremendous exertion, especially in their style of hunting. A Neanderthal was much stronger than the strongest Homo sapiens and was able to sprint at lightning speed across short distances. They needed to. Tools found at open-air sites and caves in southern England show some sophistication but Neanderthals knew nothing of bows and arrows. They needed to get closer to their prey. Most of the stone implements found were for butchering carcases and scraping hides and bones, and it seems that their spears were tipped only with sharp flakes of flint.

Injuries deduced from skeletons suggest a dangerous, even ferocious approach to hunting. Neanderthals suffered severe wounds to their heads and upper bodies and some even survived arm and leg breaks. One imaginative historian has noticed a parallel pattern of injuries to modern rodeo riders. It seems likely that Neanderthals attacked their prey directly, launching themselves at reindeer or wild horses, perhaps jumping on their backs to bring them down. Perhaps they even took on mammoths. Their weapons were almost certainly good enough to wound an animal and hunters may have stalked to get close enough and then sprinted to attack and stab. Then they chased whatever they had hit. When blood loss had weakened, say, a horse, the

Neanderthals brought it down through sheer speed and brute strength. As a dying animal kicked and thrashed, it could cause terrible wounds to its predator.

The sense of these prehistoric hunters as ferocious, attacking the prey of the grasslands with a savagery that seems barely human, is reinforced by closer examination of their skeletons. Even in identifiably younger skulls, the teeth of Neanderthals show tremendous wear and it seems that they used their mouths like a tool or a third hand. It may be that these people chewed hide to soften it and make it more workable for clothing or other domestic purposes. Their front teeth are much larger than those of Homo sapiens and curved so that they can grip as well as bite. Perhaps Neanderthal jaws were used to hold items while their hands worked on them – or perhaps they used their teeth as a weapon.

Comparative studies have revealed that Neanderthal children probably matured faster than those of Homo sapiens. And these prehistoric people also died earlier, rarely living beyond their thirties. But the impression of a feral subspecies needs substantial qualification. Neanderthals cared about their dead and buried them in what looks like a ritual manner, composing the corpse in a foetal position before covering it over. Cooperative activity such as a drive of mammoths and woolly rhinos over a cliff in what is now the island of Jersey suggests that they could plan, think consequentially and work in groups. That in turn suggests that they could articulate reasonably sophisticated speech and examination of Neanderthal skulls shows their voice box was in the same place as Homo sapiens' and therefore capable of the same range. It also appears that their culture had some abstract sense of decoration. Beads made by Neanderthals have been found and beautiful seashells collected for, it seems, no other purpose than the pleasure of looking at them and owning them.

Across the south of England, archaeologists have found evidence for the activities of Neanderthals after 58,000 BC but few skeletal remains. There is no doubt that, by this time, the herd animals at the centre of these people's lives had migrated when the climate warmed and the grass grew. But the hunters moved in tiny groups and it may be that no more than twenty or

thirty families inhabited prehistoric Britain three thousand generations ago. That extraordinary scarceness makes it very difficult for archaeologists to discover more.

Traces of the megafauna of the grasslands have been found in Scotland – mammoth tusks have come to light in a dig near Kilmarnock, on the watershed hills between the Ayrshire coastal plain and the Clyde Valley. Perhaps it was killed by cave lions. But nothing of the northern forays of pioneering Neanderthal hunting bands has been found even though it seems certain that they followed the herds as they sought fresh pasture. No characteristic assemblages of their tools have yet been uncovered, and what happened after the time of the mammoths, hyenas and lions in Scotland erased almost everything and makes it highly unlikely that any will ever be recognised.

After 24,000 BC the skies over Britain began to darken, storms blew and the weather quickly grew colder. Winter snow stayed on the hilltops throughout the year and the summers shortened. New grass came through later and later and began to die away in the early autumn. As rain and sleet fell, the great herds were driven southwards and, when the cold gripped the land, their human predators fled with them. The last Ice Age was beginning.

The causes of this drastic episode of climate change originated far out in space. For reasons related to the fluctuating gravitational pull of our Sun and the planets, the Earth's orbit changed. For long periods in the last 500,000 years, it has revolved around the Sun in an ellipse and not a near circle, as it does now. At the extremes of an elliptical orbit the Earth is further from its source of heat and light and therefore temperatures drop dramatically. Added to this cycle of change is another deadly complication. Over the last half million years, the angle of the Earth's axis has also altered, tilting the northern hemisphere away from the Sun's rays. This has the effect of shifting the Arctic Circle several hundred miles southwards. In turn this depresses temperatures even more as the cold waters of the north Atlantic began to turn away the warmth of the Gulf Stream.

Over northern Europe, the ice crept down the hillsides and

covered the frozen land. As hurricanes blew and storms raged, more snow fell and it reflected the Sun's rays back, insulating the ice beneath, and temperatures dropped ever lower. Across the highest points of the ice sheet that had formed over Scotland, it was an average of −60° Celsius.

Nothing could live. At the height of the last Ice Age, the ice sheet over Scotland was more than a mile thick and it extended far to the south, to a diagonal line from the South Wales coast over to the Humber Estuary and a small enclave immediately to the north. It was a pitiless and utterly sterile landscape. As air flowed down from the summit of the ice dome over Ben Nevis and Rannoch Moor, tremendous winds blew, their extraordinary speeds enhanced by the lack of friction from the ice. The near-constant high pressure produced clear skies and endless white vistas of dazzling but devastating beauty.

To the south of the sheet, conditions were different but equally extreme. At the fringes of the ice, where the glaciers had begun to fray and crumble, low pressure fronts travelled along the cliffs at the edge of the sheet and they brought sleet, cloud and very stormy conditions. Over all, the seasons' temperatures averaged −10°. Below the line from South Wales to the Humber, southern England was a polar desert and had been entirely abandoned by animals and people. So much water had been locked up in the ice that global sea levels were lowered by 125 metres and those fleeing frozen Britain could walk far to the warmer south. A broad region of steppe-tundra covered northern Europe and it was only south of the Loire Valley that refugees could travel over grassland and see the welcome herds of grazing animals. Those northern Neanderthal bands who sought refuge in the south also came across another species.

Around 40,000 BC Homo sapiens arrived in Europe, his ancestors having migrated out of eastern Africa 30,000 years before. Although slightly taller, these new people looked like modern humans and we are their descendants. They spoke a developed language, possessed many skills and, as family bands crossed Europe from east to west, they thrived. Neanderthals had been hunting the grasslands and the forests for at least

100,000 years before and it seems that, for a period, both subspecies co-existed. Numbers were very small – only 5,000 or so people hunted in the whole of the area of modern France – and contact was probably rare. Europe was dominated not by people but by animals, the huge herds and the megafauna of the time before the onset of the last Ice Age.

Spearheaded by the panzer corps led by Generals Guderian and Rommel, German armies smashed into northern France in May 1940. Refuelling at roadside petrol stations, ignoring orders from Oberkommando der Wehrmacht (OKW) General Staff to halt and consolidate, the panzers dashed for the sea and the encirclement of British and French forces. Stukas dive-bombed a smoking path through French defences and, after the miraculous evacuation from Dunkirk, France fell, its armed forces surrendered and a humiliating armistice was signed in the forest at Compiègne. By 28 June, Adolf Hitler was sightseeing in Paris, triumphant, the master of Western Europe.

Southern and eastern France remained unoccupied and under the control of the collaborationist Vichy Regime of Marshal Pétain. Throughout the summer of 1940 the sun shone and life in the south appeared to go on much as before, although many must have been fearful of the future under a government absolutely controlled by the Nazis. But for young people, these concerns were perhaps less immediate.

On Sunday 8 September 1940 another sunny day dawned and it was buried treasure and not the war in the north that was much on the mind of seventeen-year-old Marcel Ravidat. An apprentice garage mechanic in the small town of Montignac in the steep-sided valley of the River Vézère, a tributary of the Dordogne in the Périgord region of central France, he had heard stories of a mysterious hidden cavern in the wooded hillside at Lascaux. With three friends and his dog, Robot, Marcel walked out of the town on a road leading to an abandoned chateau. Older people had said there was a secret passageway under the house which led to a cavern, a place where treasure had been buried. During the Revolution a priest known as Labrousse had fled the Terror and

the guillotine by seeking refuge in the secret cave. Because the chateau had belonged to his family, he knew where to find the entrance.

The steep hillside behind the old house had been planted with trees and allowed to revert to wildwood. In the winter of 1920/21 a great storm had blown through the valley of the Vézère and brought down a mature pine tree. Its roots torn out by the force of the wind, the pine had left a surprising large hole and to prevent browsing animals from falling in, farmers had filled it with earth and rubbish.

After a fruitless few hours thrashing through the wildwood Marcel and his friends had found nothing and began to make their way down the hillside back home to Montignac. However, Robot was nowhere to be seen. Despite repeated calls and cajolements Marcel could not bring his dog to heel and the exasperated friends set off to look for him. Behind a tangle of brambles and scrub, Robot was found digging furiously, earth flying out behind the little dog. He was at the bottom of the gaping hole left by the windblown pine tree and when Marcel scrambled down to pull Robot away, he saw that the determined dog had dug another hole. Only six inches across, it seemed to lead into total blackness. Excited and intrigued, Marcel dropped some stones into the opening – and they clattered away, echoing into what seemed like endless emptiness. The boys looked at each other. Had Robot found the entrance to the secret cavern of Lascaux? Was there treasure down there? They resolved to say nothing to anyone and to come back another day with ropes, lanterns and shovels.

Equipped with a crude lamp and a long knife-like implement he had made himself, Marcel returned on 12 September to try to widen the hole. Robot had been left at home – this was serious business. Having brushed through the brambles and scrambled down to where the dog had been digging, Marcel soon reamed out enough to allow him to squeeze through. Clutching his lamp, he went in headfirst and promptly slid downwards into the darkness for about 20 feet. Unhurt, he managed to stand up and light the lamp – and then slipped and fell again. The lamp was

snuffed out as Marcel was pitched forward. He could see nothing and must have been terrified, but his headlong descent was quickly broken by flat ground. Having had the presence of mind to hang onto his lamp and only scraped and bruised, he stood up and lit the lamp again. He could see that he was in a large cavern. In the darkness and silence around the boy astonishing figures were waiting to be revealed.

Once his friends had skidded down, Marcel led them into the heart of the cavern. Anxious not to fall again and with no idea of the gradient, he held the lamp at knee height. But when the boys shuffled slowly into a narrow corridor, they stopped on the firm ground and Marcel lifted up the lamp for the first time. Jacques Marsal gasped and cried out loud at what he suddenly saw. Galloping across the walls of the cavern were herds of wild horses and bulls. As the lamp flickered across the images, the animals seemed to move. And when the boys looked around they were open-mouthed, literally entranced. Much later Marcel recalled their reaction: 'a band of savages doing a war dance couldn't have done better'; while Marsal said, 'We were completely crazy'.

What little Robot had found was something remarkable, something that ranks as one of the wonders of the world. Inside the labyrinth of caves and caverns at Lascaux were almost 2,000 paintings of animals, most of them wild horses, stags, bison and at the entrance four huge black bulls. But what made these a wonder is that the menagerie of beautifully painted creatures was made some time around 15,000 BC, when most of Europe shivered in the grip of the last Ice Age.

This was treasure certainly but not what Marcel and his friends had in mind. The boys thought it best to tell their schoolteacher, M. Leon Laval, what they had found and he left a record:

> Once I arrived in the great hall accompanied by my young heroes, I uttered cries of admiration at the magnificent sight that met my eyes . . . Thus I visited the galleries and remained just as enthusiastic when confronted with the unexpected revelations which increased as I advanced. I had literally gone mad.

What stunned M. Laval and later observers was the vibrant quality of the painting. Not only were the animals life-like, they seemed to move, be full of energy – even magical. A representation of a bison with one of its hind legs crossed behind the other and a gap left between it and its torso shows a mastery of perspective. This sort of skill was not seen again in Western art until the Italian Renaissance of the fifteenth century. And when Pablo Picasso visited the caves after the end of the Second World War, he was much moved and commented, 'We have learned nothing in 12,000 years.'

Lascaux is not unique. In southern France and northern Spain, essentially on either side of the Pyrenees, there are 350 caves with paintings (and also many engravings carved into the rock with flint chisels) on their walls. They were made by small communities of hunters, all of them Homo sapiens, between 30,000 BC and 8,000 BC. This was the time of the last Ice Age and the caves are found only in the areas known as the Refuges. These were the places where refugees found shelter from the bitter winds and harsh winters, and where the climate allowed plant and animal life to thrive sufficiently to support small populations. Many of the painted caves of the Refuges are found in valleys like the Vézère. The cliffs sheltered people from the worst of the weather and the rivers at their foot watered the herds of reindeer and wild horses as they migrated across them, seeking the summer grasslands.

Aside from their patent beauty the point of these paintings is mysterious. Made in darkness, lit only by flickering torches, their style is amazingly consistent over a tremendous span of time, for 22,000 years, the long lifetime of the Ice Age Refuges. Using mineral-based paints such as red and yellow ochre, charcoal and pads of fur or moss or brushes of animal hair to apply fields of colour, they sometimes seem chaotic with animals painted over each other. But in the Hall of the Bulls at Lascaux, where Marcel Ravidat first tumbled into a darkness undisturbed for 17,000 years, the composition looks as though it was organised by one directing mind and clearly intended to be seen from a single viewpoint in the approximate centre of the floor of the cavern. Skills of all kinds were clearly passed on and often paintings were

made in places only reachable by scaffolding. The cave art of the Refuges is an extraordinary achievement.

The bulls, the bison, the lions and the mammoths are magnificent, sometimes painted on a monumental scale. By contrast people are usually represented by stick figures, quickly sketched and often incidental to the riotous gallop of the herds and the pounce of the predators. This artistic preference must reflect the painters' sense of the world outside the cave. It was a world overwhelmingly inhabited by animals, thousands grazing the wide grasslands, drinking from the rivers, migrating south in the winter – it was not yet a world made by men and women. There were so few amongst the teeming herds and the ferocious killers who hunted them and who terrified those who saw them attack. Packs of hyenas as big as lions were persistent and deadly, their huge jaws able to snap bones and tear off gouts of flesh. In wet places traversed by winding paths through willow scrub and birch woods, wolverines would climb trees and hide themselves, crouched and waiting. When deer or antelope forced to keep to the path passed below, the wolverine jumped on its back, digging in its razor-sharp claws to avoid being bucked off. As the agonised animal bolted in panic, running away from the appalling pain, the wolverine tore at its neck muscles until the vertebrae could be cracked. The world outside the caves did not belong to men but to the great herds of prey and their savage predators.

In 1994 the Chauvet Cave was discovered. Its paintings had not been seen for 27,000 years and many were of the great predators of the grasslands and the wooded valleys; lions, bears or large and dangerous animals not normally hunted such as rhinos or mammoths. Ten thousand years later when the painters began work at Lascaux, very many fewer predators stalked the walls. Had men replaced them at the top of the food chain? And if the world outside was less dangerous for hunters, why did the prey of the grasslands inhabit their imaginations?

Some animals seem to be featured more strongly than others. Horses gallop through Lascaux, bulls or bison or cattle dominate elsewhere. It may be that the hunting bands adopted an animal as its totem. Linked to the herds by necessity and forced to follow

them if they moved or exhausted their ranges, the hunters and their painters may have attempted to anchor them in one place by making their likenesses, something of their essence, in the secret places under their lands.

In unpacking this notion, parallels begin to suggest themselves. Throughout different cultures and periods of history, caves have been seen as the entrances to underworlds, transitional places between the light, open-air world of the surface of the earth and what lies beneath. Just as the much later prehistoric farmers buried their dead in the land they had cultivated in order to underline to outsiders that it belonged to them and in that way make a reality of their possession of it, so the hunters of the Refuges may have tried to bury symbolically the animals in the land they grazed – to keep them close, and at least in one sense, to own them.

On the island of Rousay, in Orkney, there were thirteen townships in the nineteenth century and in each there exists the remains of an ancient chambered cairn, a tomb. Some time around 3,000 BC the Farmers buried their dead in the land they toiled over so that there could be no doubt or dispute that this was the kindred ground in every sense.

Animals may also have been adopted by the bands of the Refuges as totems in another way, that is, they identified with them very closely. Perhaps the Horse Clan of Lascaux painted so many of them because they admired their speed and beauty, hoped that they might share their virtues and not only because their livelihood depended on the herds.

The caves are atmospheric places, often cool, often echoic, and away from the mouth, black dark. Painting was not only done by torchlight, it was also revealed by the yellow flicker of flame. Rituals associated with magical revelations in the darkness are not hard to imagine. If sound effects were added – snorts, whinnies, roars and thundering hooves – then there may have been a sense of powerful son et lumière. Bone flutes have been found by archaeologists and with the widespread use of hide in all sorts of domestic applications, the taut and resonant skins of drums must have been an early invention. At festivals and

parades through Britain's summer streets the ancient sound of fyfes and drums is still heard.

The form of rituals involving the animal paintings, music, song and dance can be guessed at but no detail has come down to us. But that these rites were long-lived there can be no doubt. As late as 1458 Pope Calixtus III (from Valencia) rebuked nominal Catholics in the northern mountains of Spain for performing rituals in 'the cave with the horse pictures'. Tantalisingly, no details are given.

Trances may have been induced in the airless painted caverns, either by dancing or exertion in places where there was little oxygen. In several chambers at Lascaux pockets of carbon dioxide build up naturally and have caused evacuation in recent times. Transcendent states may have been induced in the Hall of the Bulls and other larger spaces, or perhaps in tiny claustrophobic passages. Another Orcadian example illustrates. At Mine Howe a winding corkscrew of a prehistoric stairwell bores into the ground to lead to a tiny sensory deprivation chamber where individuals may have stood alone in the darkness, hoping for visions in the chill and damp bowels of the earth.

Perhaps the most arresting images at Lascaux and the other caves are not the extraordinary animals. Filling their mouths with paint, men placed their hands flat against the cave wall and, either directly or through a pipe, sprayed them. The effect is like a stencil, leaving a handprint on the wall, a sort of eerie, fleeting signature.

When the excavators entered the amazing painted caves at Chauvet in 1994, they knew for certain that no one else had seen them for 27,000 years. Undisturbed across all those millennia, footprints were found on the clay floor and there were two clay-stained handprints on the cave wall. It seems that a ten-year-old boy, carrying a torch that left charcoal marks as he walked on, had visited the magical cave – alone – just before it was lost to history. The image of an awestruck little boy staring at the mammoths and the lions is powerful and mirrored by the wonder that overwhelmed Marcel Ravidat and his friends almost 30,000 years later.

The cave paintings are a unique record, a pungent, highly coloured legacy left by our oldest direct ancestors. Compared to the dusty collections of flint arrowheads, hand axes and skeletal fragments, they flicker with life and speak of a vivid world inhabited not by prehistoric shadows but by the flesh and blood of men, women, children and animals. On the cave walls are glorious examples of virtuoso artistry, humour, humanity and enigma and they announce the arrival and survival of people like ourselves in Europe.

What is even more remarkable is something very simple – the ability of the paintings to move us profoundly, to be awestruck like Marcel and his friends. It is a reaction reaching across thirty millennia to touch us and draw the little boy with the torch and our ancestors closer. And more, if the painters of the Refuges could make great art to astonish Picasso and all who have seen them, then how can they seem to be lesser beings, primitives or savages?

Their skill and sensitivity are not the only link to bind us. We carry the memory of these remarkable people inside our bodies. When the weather at last warmed and the hunters could leave the Refuges and their caves, they began a journey to the north, a genetic journey to Scotland. Their DNA has survived and some of the descendants of the men and women who hunted and painted the bison and the wild horses now live in Scotland. This is the story of their journey home.