

# DISCOVERY

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NEW RESEARCH TOOLS FOR THE ARCHAEOLOGIST

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(Mt Wilson and Palomar Observatories)

## THE EVOLUTION OF "HUMANS" ON OTHER PLANETS

WILLIAM HOWELLS

*One guess is that there are about a hundred million worlds where higher forms of life have actually been forged by evolution. Intelligent beings must abound in the universe, most of them far older than we ourselves. But what will they look like? Would "humans" evolve again on Earth if we wiped ourselves out?*

The coming of Man on Earth has been extremely slow, his preparation long. We know, through millions of years, what powerful forces brought us out. We see what boons we have in skeletons, jaws, limbs, warm blood. Homely things, but with them any mammal is a testament of evolutionary creation. Add fingers and acute eyes, and you have something like a monkey. Add true hands and legs and you have the beginnings of a man. Then natural selection made our brains, and everything we do with them.

All this came gradually, in due course. Each patient step made possible the next. Each step gave rise to hundreds of kinds of successful animals, perfect in their own ways. Man himself could only appear when a very high organisation had been attained. For hands and a big brain would not have made a fish human; they would only have made a fish impossible. Man's own

*William Howells is Professor of Anthropology at Harvard University and a past president of the American Anthropological Association. This article is from his book, "Mankind in the Making", just published by Secker & Warburg.*

trail, among the many trails in evolution, was well defined: he had to be a mammal and he had to be a primate.

Was he inevitable? Mankind long thought so, and Genesis entertains no doubt that the world was made for us. Being human, we find it hard to see things any other way. Not long ago it was shocking to ask whether man had evolved from other animals. It is doubtless equally shocking to ask whether man arrived simply as a matter of luck.

Actually it would be a futile question. One cannot pass judgment on such a thing without going straight on to the origins of the universe. It does not matter here what your religious views are, for man must be looked on as an extraordinary achievement of design and organisation. The universe itself is built on laws of matter. These are the foundation for laws of life; and on such a basis, we know, man at last came on the scene. He was not there to begin with, and he took a long time coming. But he came, and he expresses all the fullness of the possibilities of the organisation of life as we understand it. How much of this is "chance"? There is no present answer.

I am not really trying to be profound, and I have little space here in any case. Talking about chance, I am merely wondering if man was forced to take the shape he did. If we had it to do over again, would we choose all the same forks in the road, or would we turn out differently? Perhaps science fiction has the answer.

Doubtless there are other "men" in space. Led by the astronomers, we now face possibilities of life elsewhere at which the mind boggles. We know there are many billions of stars in our own particular galaxy, the Milky Way. Galaxies like ours are grouped in clusters, thousands to a cluster, and such clusters go on and on, out of reach of the telescopes, by the hundreds of millions. Planets to live on? Dr Harlow Shapley has figured it out roughly.\* Not many stars have planets around them, he thinks; perhaps one in a million. As in our own system, few planets are of the right kind, with water, days and nights, favourable temperature and chemicals, and so on. Perhaps one good place in about a

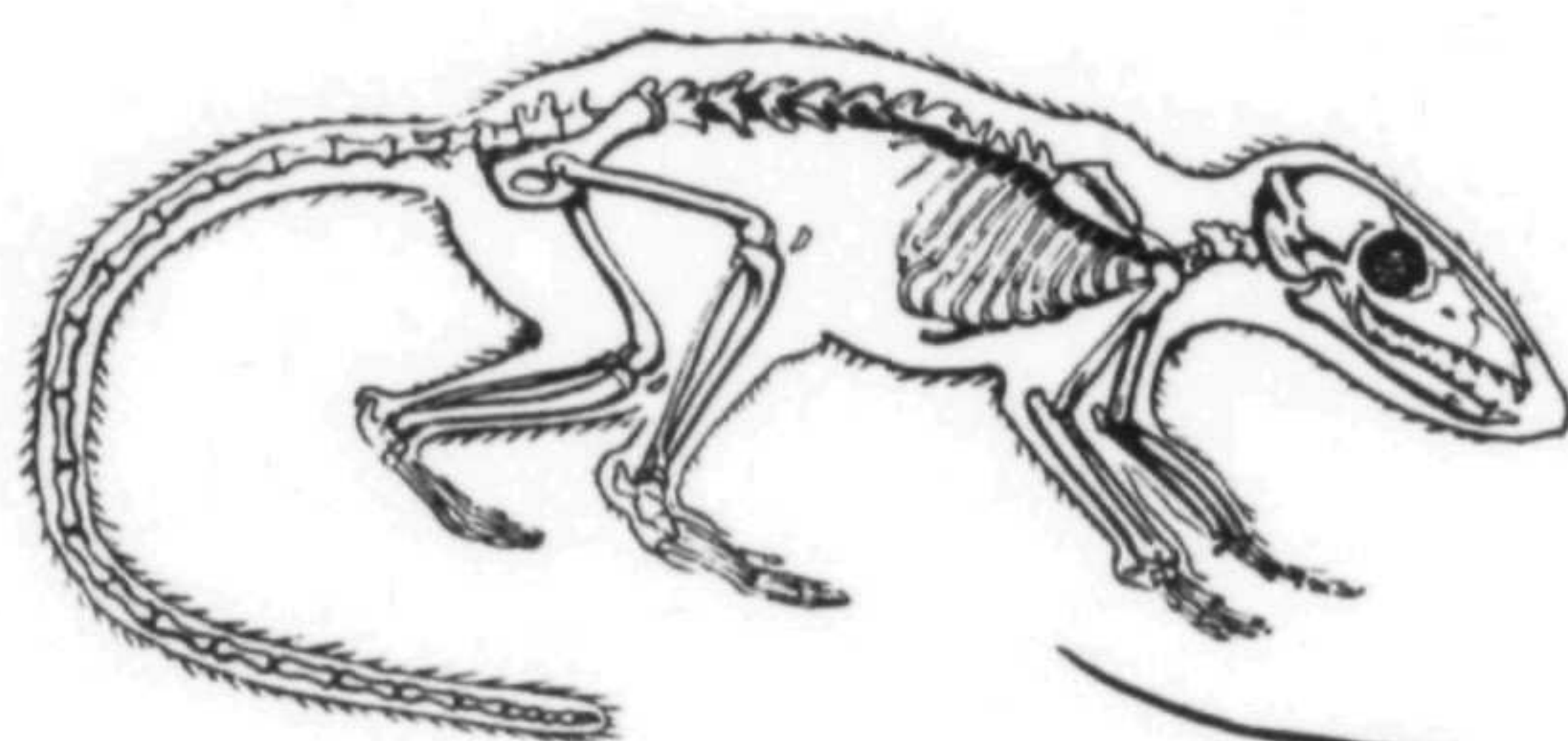
\* In *The Atlantic*, November 1953.

trillion stars, all told. But these are really splendid odds, considering the number of stars; Dr Shapley ends by guessing that there are about a hundred million worlds where higher life has actually been forged by evolution. "We are not alone." Intelligent beings abound in the universe, most of them far older than we ourselves.

We can try to imagine what such people are like. Here we get little help from the comic books, which only show us flying saucers, manned by flabby little web-footed goblins with knobs on their heads. We must be strictly scientific, starting from scratch and assuming nothing about the beings we are studying, except that they are "intelligent". But this at once means that they are "human", in the sense that they have culture, like ourselves: they communicate ideas to one another, and create things jointly. Otherwise intelligence means nothing. And we could never communicate with them, if they could not already communicate with each other.

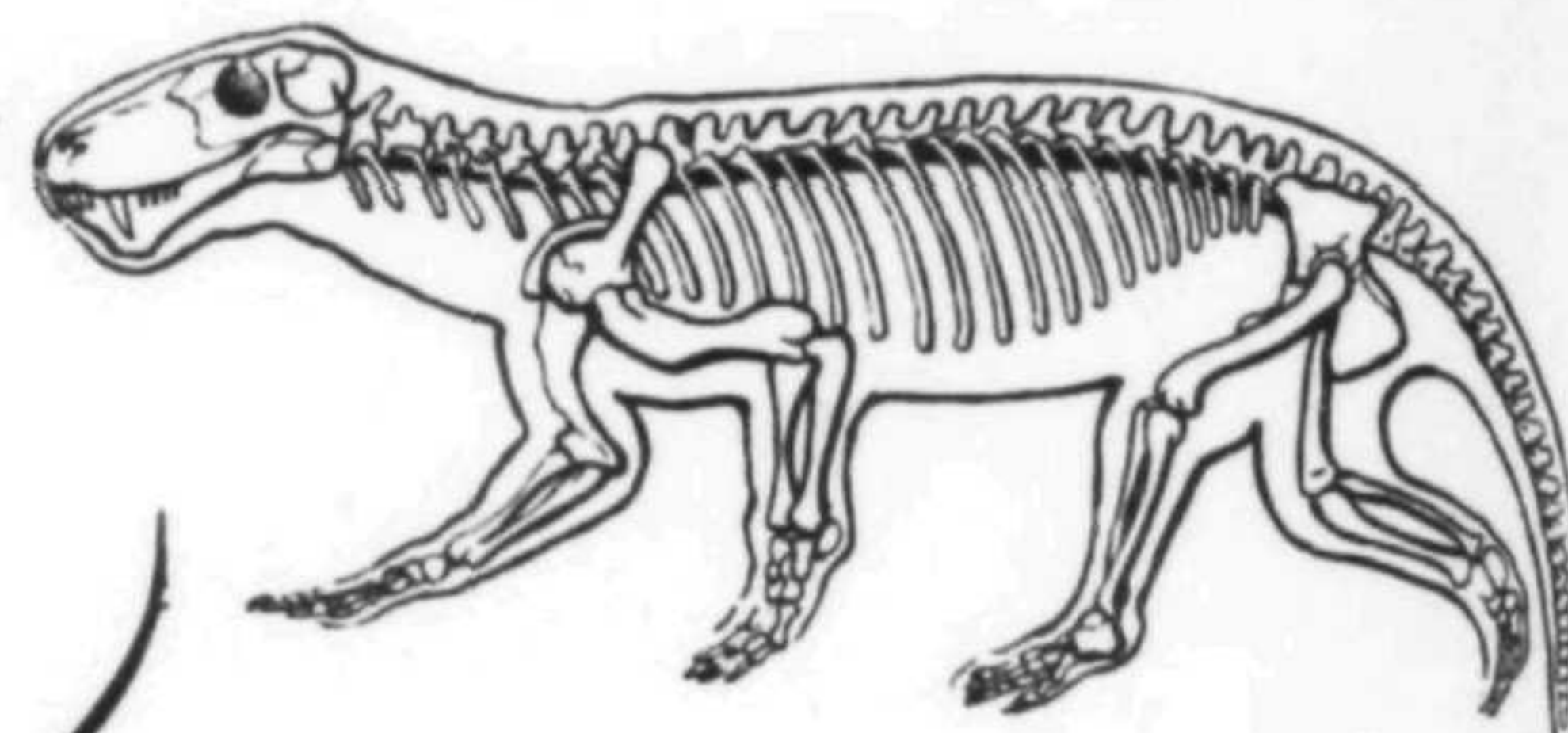
Furthermore, we might just as well imagine them on a favourable world something like ours, in matters of temperature, gravity, some atmosphere and land surface, and so on, since it seems to be the kind most suitable for life. Very well. We have intelligent, communicating creatures, on a far-away Earth. Are they anything like us? I think they are.

They might be considerably rearranged. They might "see" things we only "feel", like heat wavelengths; or "feel" things we "hear", and so on. Their "bones", or whatever props them up, might be differently placed in relation to blood vessels and nerves. But they would have these things. Communicating, creating creatures must have motion—they could not be like trees, with little power to act and exert force. So they would have to be self-contained, moving about and getting their fuel like the animals of this world. They would need structure, and a nervous organisation probably using electrical nerve impulses. They would need a liquid transportation system; we can hardly suppose that nourishment flows through their veins in the form of breakfast cereal. And so they must have begun their evolution, as we did ours, in a liquid medium, say water.



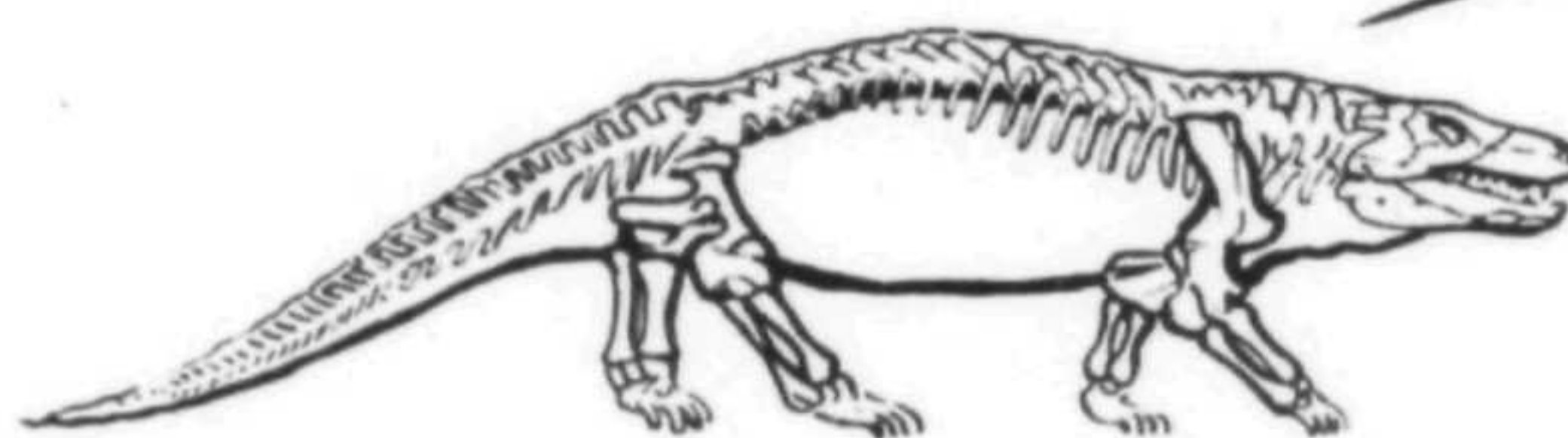
PRIMITIVE PRIMATE  
Tree shrew, Tupaia

MAMMAL-LIKE REPTILE  
Lycaenops



REPTILES

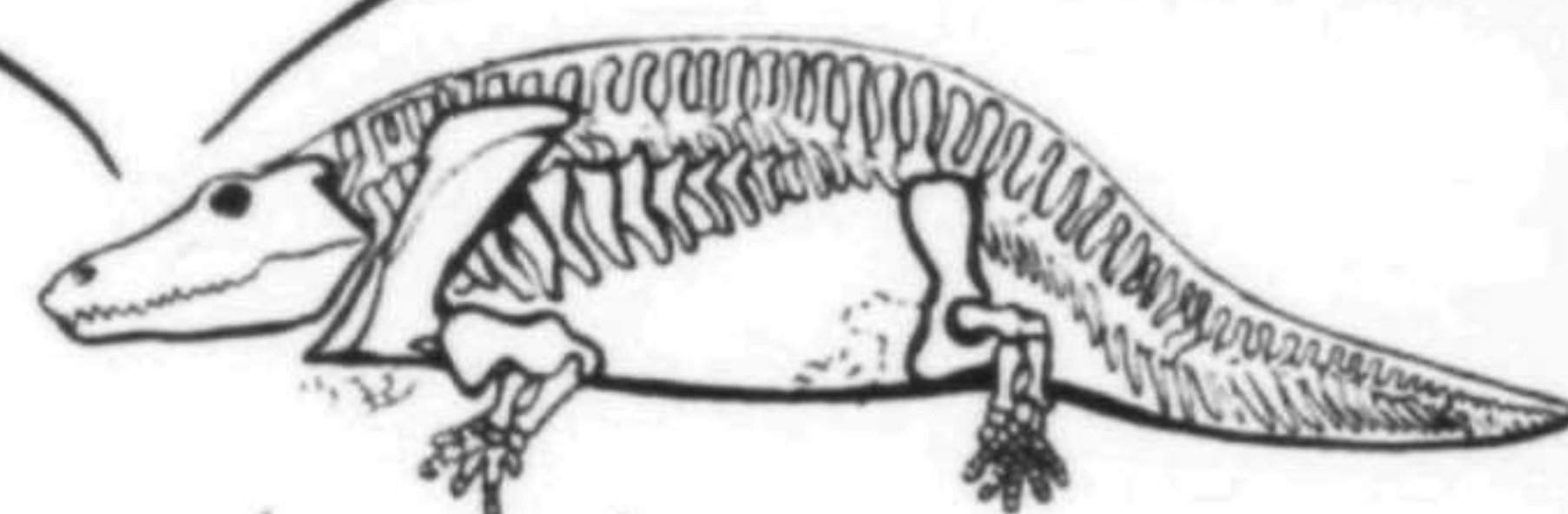
DINOSAURS



EARLIEST REPTILE  
Seymouria

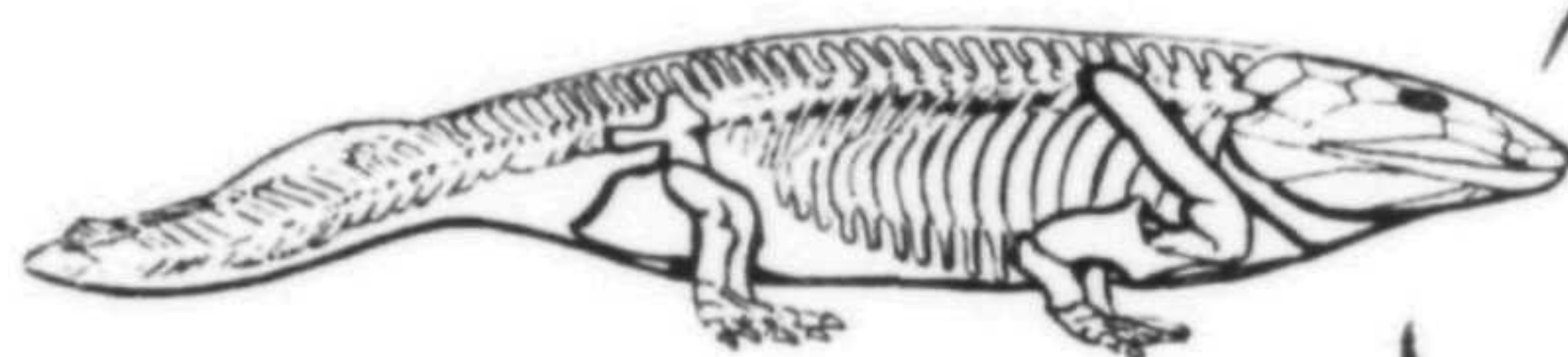
AMPHIBIANS

EARLY AMPHIBIAN  
Eryops

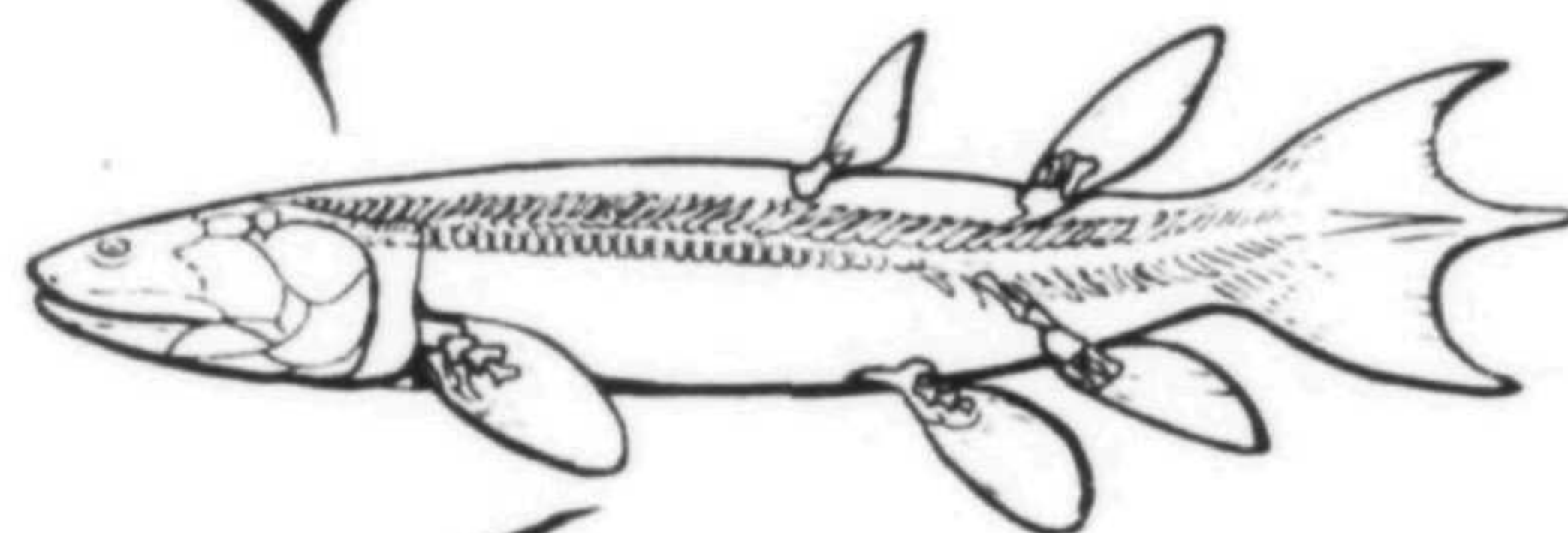


PRIMITIVE AMPHIBIAN  
Ichthyostega

COELACANTHS



LOBE-FINNED FISH  
Eusthenopteron



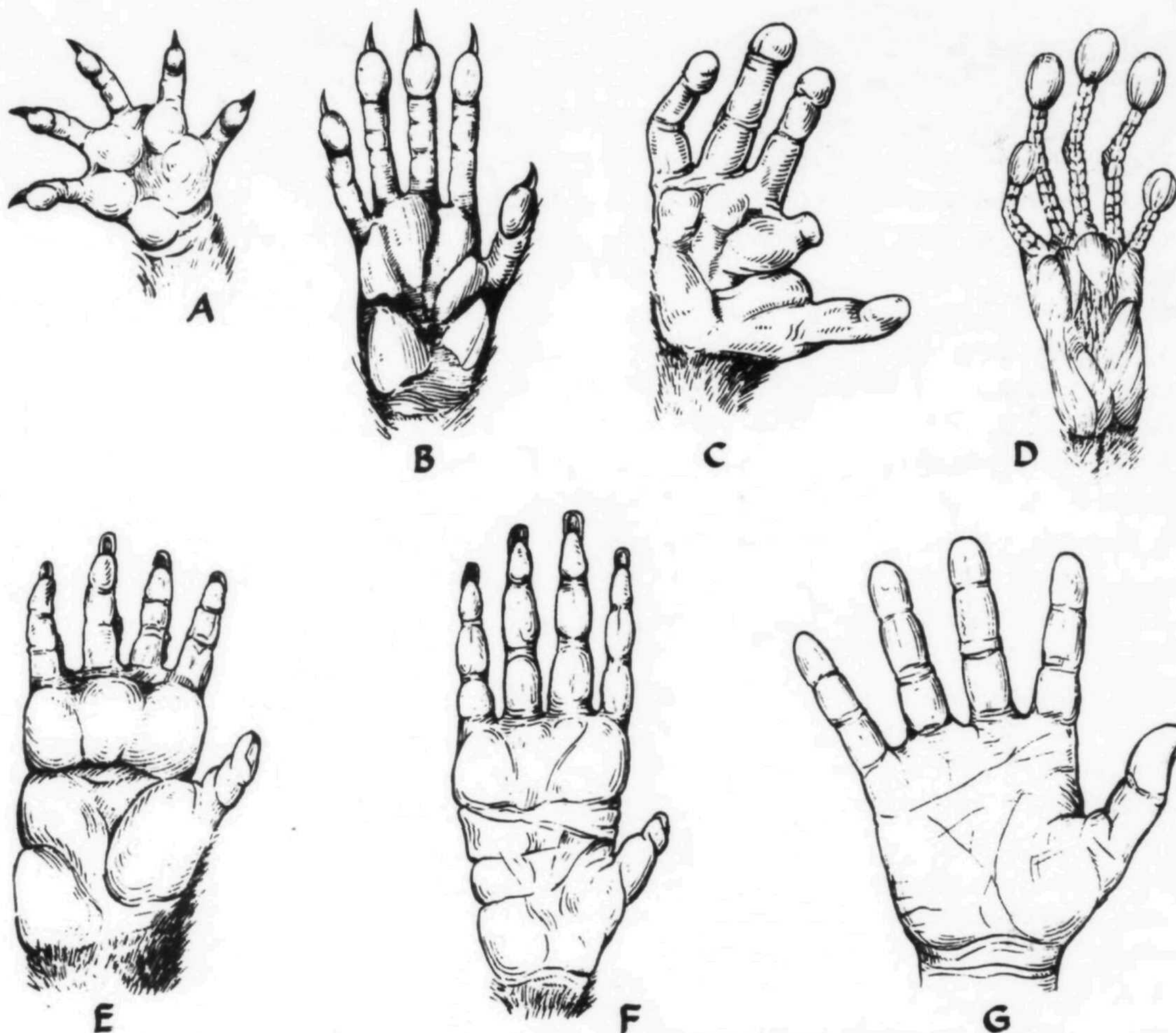
Will they be standing up and walking around like us? Might they not have two hands and four legs? Do we do anything well that a centaur could not do better? We go around on two legs because we had no other alternative if we wanted hands to use. The choice existed once, in the early fishes, but the lobe-fins and amphibians chose to keep only four limbs out of the original stock of fins. I will lay a small bet that the first men from Outer Space will have four legs and one pair of arms and hands.

(Above) Animals lying on, or close to, the line which led to man between fishes and mammals. (After Gregory, Jarvik, and Romer.)

(Right) Skeletons of forelimbs, showing adaptation to the different uses: (A) the proto-mammalian pattern in a mammal-like reptile; (B) a horse, highly modified by lengthening of the lower part and loss of separate fore-arm bones and of side toes; (C) man, with a general retention of the basic pattern. (Partly following Gregory.)

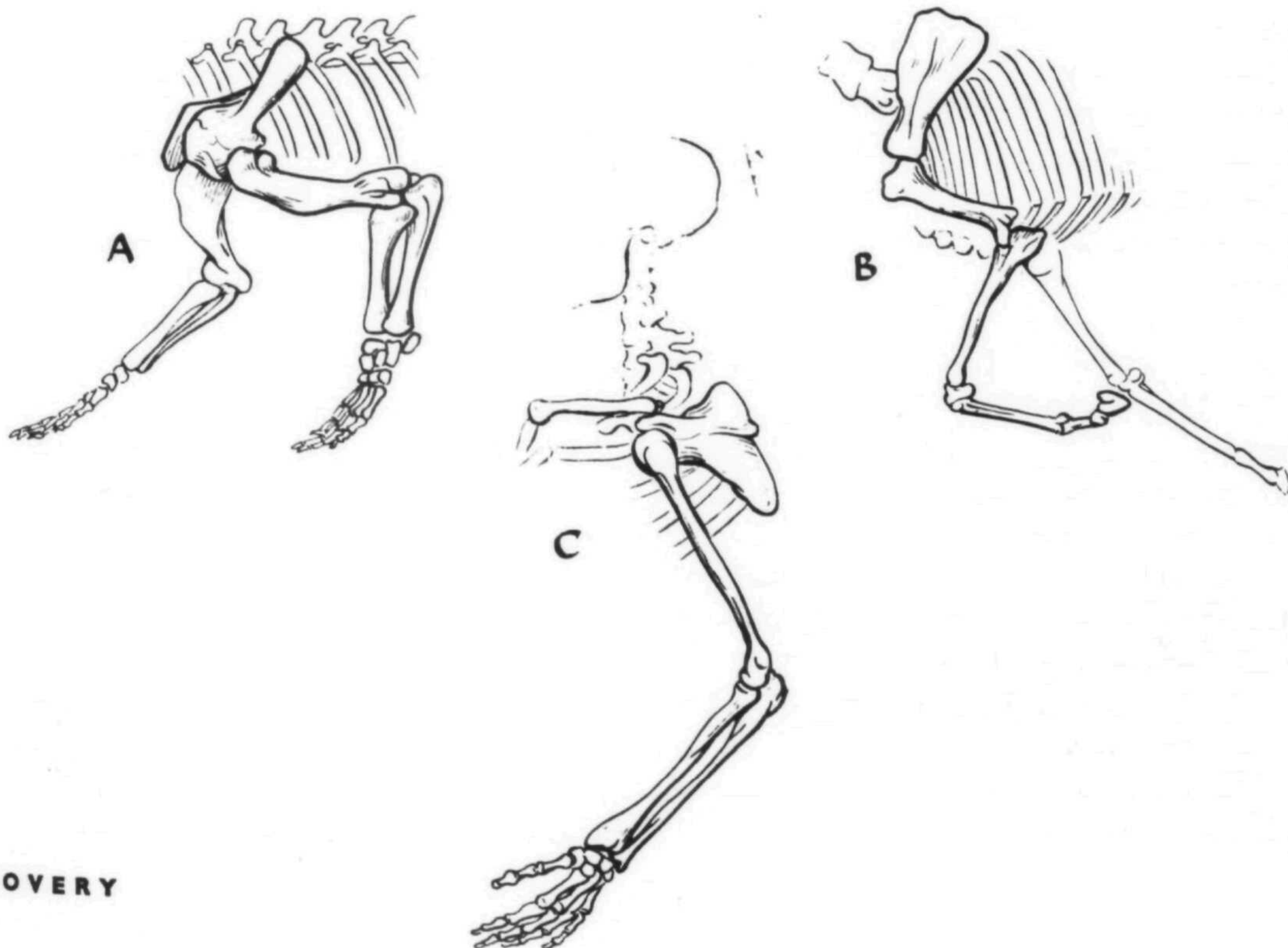
So much for raw material. What about design? Are the stragglers round, or flat, or pointed? Do they smell through tail-fins and see through a radiator grill? The chances are excellent that they have a head end (which implies a tail end as well), because almost all the animals of this world which can move alertly and exert any real force are built on this same plan. It puts the senses where they will do the most good. And the main centre of the nervous system is close by, so that sense impulses will not have to make a long journey aft to a brain in the rump. Therefore our men will have heads. And, like the more efficient of our own animals, they will doubtless do their eating at this end as well. So, if they are going to be intelligent, our distant cousins had better be plotted something like a vertebrate or an insect of our own vicinity.

But they will do well not to imitate insects, for many reasons. All the co-operation of insect life—warrior ants, worker bees—is printed on the nervous system of each single insect. They act without benefit of ideas, only from instinct. Their social “ideas” come from natural selection alone, not from thought. So intelligent creatures will have made a choice, early in evolution, of a nervous system which is more open to fresh impressions: a brain which can learn. Eventually such a brain will become large. Come to think of it, it will make quite a lump somewhere, probably in the head.

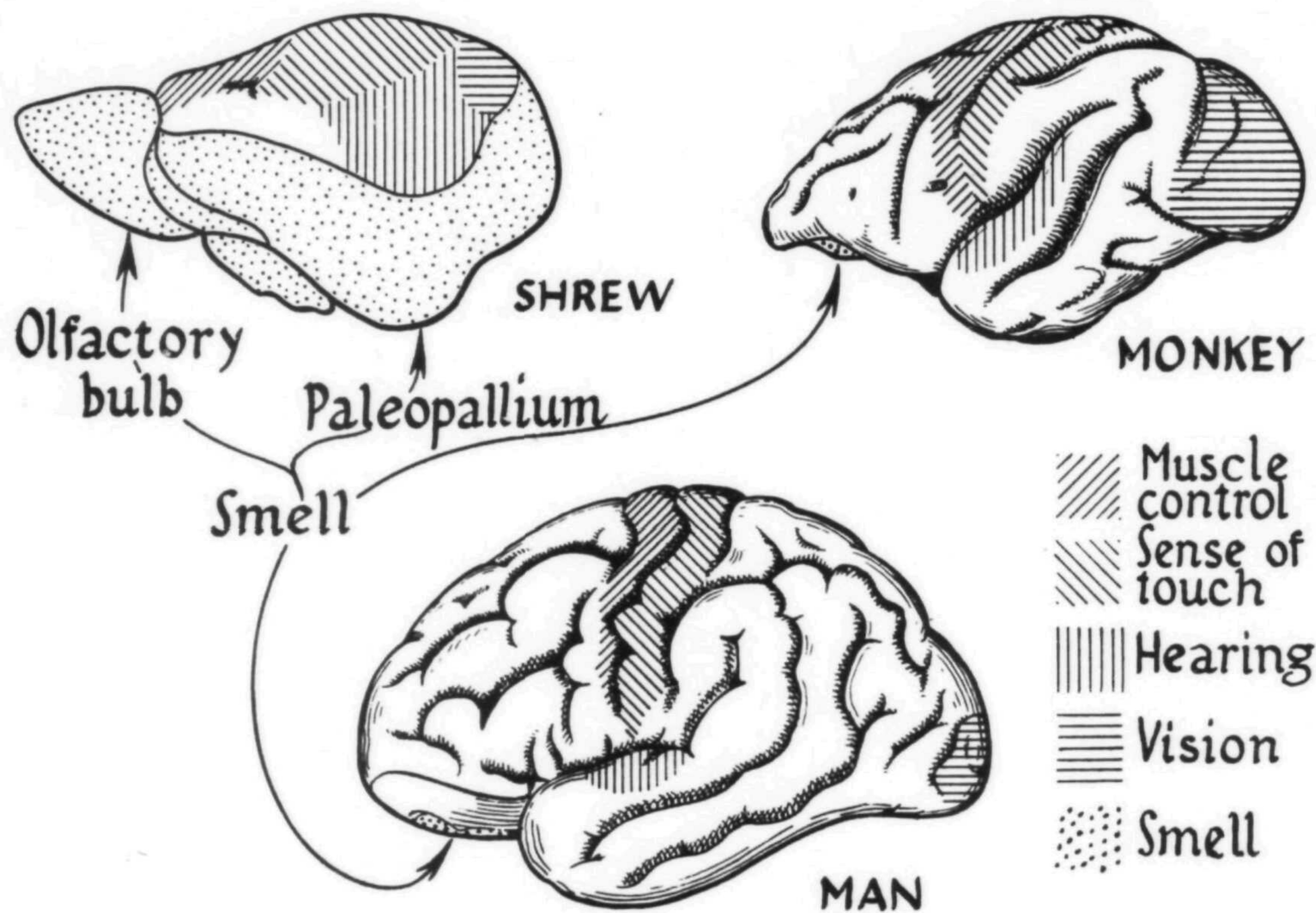


The hands will be better with fingers on them. There need not be five. Perhaps a few more or less will serve, but you may have been struck by the fact that we have decidedly kept all five of the bunch handed down to us by *Seymouria* and his forefathers. So five seems like a good number, perhaps a minimum. Therefore, look for plenty of fingers, on the ends of two arms. Two arms—not three—because the creatures should be symmetrical like us, and not four because co-ordination would probably be too difficult for efficiency.

(Above) Hands of (A) the opossum, primitive but mobile; (B) the tree shrew, with simple primate proportions; (C) the galago, using thumb and fourth digit for greater span, the second digit being reduced; (D) the *Tarsius*, a small hand with specialised enlarged skin pads; (E) the baboon, generalised in pattern; (F) the orang, lengthened for brachiating, with reduced thumb; and (G) man, with short fingers and long thumb for good opposition.



While we are roughing out shape, we might ask whether such a species will come in more than one form. Bees and ants do. And caterpillars turn into moths. Above all, the great majority of living things come in two sexes. It is one of nature's most popular ideas, and not for the first reason that will occur to you. Sex ensures a great plenitude of new gene combinations, different in each of the offspring, through the coming together of genes from two parents. This is one of the keystones of evolution, as you have seen. We on earth have long ago made all our arrangements on the basis of two sexes. Perhaps our extra-terrestrial equivalents have three sexes, like German nouns. Or more; who is to say? Certainly two is most likely. It is an almost universal rule here below, with no complaints.



Its brain—or whatever it operates on—must be absolutely large. There is no reason to suppose that the basic cells and fibres of the brain could be substantially smaller than the same things here, so there should be no saving of mass.

(Above) The cerebral cortex of some Earth mammals as seen from the left side (not drawn to scale). In a primitive mammal (insectivorous shrew, not to be confused with the primate tree shrew) most of the cortex is related to smell; the paleopallium is large and there is a prominent olfactory bulb in front to which the olfactory nerve leads from the nose. The neopallium (above) is still relatively small. In a monkey (macaque), the neopallium is greatly expanded, being all that is visible externally, and the olfactory areas are recessed under the forebrain. There are considerable association areas between those devoted to special senses. In man, the brain is larger still and highly convoluted. Association areas form a larger proportion of the cortex.

We now have a Thing with one head and two sexes. (Two heads are *not* better than one; making up a single mind is more than most of us can do, as it is.) We had better assume that It goes on land. The water is far less promising as a medium for creation and communication, though perhaps not impossible. As for air, the birds have found that it does not work out well, if the goal is intelligence. Birds are beautiful but stupid, having been obliged to put their brain development largely in the service of co-ordination of movement, for flying.

Being on land, these men will have limbs as well as a head. They must have limbs, because they must have hands. If we can learn anything from our evolution, it is that we had to be able to *do* things to become human. And our whole struggle was the getting and freeing of hands to do them with. Surely, we would not have had large brains without them.

The hands will be better with fingers on them. There need not be five; per-

haps a few more or less will serve. But you may have been struck by the fact that we have decidedly kept all five of the bunch handed down to us by *Seymouria* and his forefathers. So five seems like a good number, perhaps a minimum. Therefore look for plenty of fingers, on the ends of two arms. Two arms; not three, because the creatures should be symmetrical like us; and not four, because co-ordination would probably be too difficult for efficiency. Centipedes have to run their arms in teams.

Now for a big question. Will They be standing up and walking around like us? They would not look very human otherwise. But might they not have two hands and *four* legs, that is, three pairs of limbs? Insects have. Do we do anything well that a centaur could not do better? We are reasonably content with our own seating arrangements, but perhaps we are making the best of a bad job. You know already why we go around on only two legs: if we wanted hands to use, we had no choice.

The choice existed once, in the early fishes. But the lobe-fins and amphibians chose to keep only four limbs out of an original larger stock of fins. Unimaginative beasts, what was good enough for a bedstead was good enough for a labyrinthodont. And so these feckless ancestors nearly slammed the door on hands entirely, since later hand-users (or wing-users) among the vertebrates had to manage by balancing on the two remaining legs. Supposing that ancient vertebrates had found some simple use for an extra pair of forelimbs, like the insects, while they still had the chance. Then these forelimbs might have continued being sufficiently adaptive for evolution to hang on to, as their possessors came out on land. Had this happened, we might all have avoided the problems which turn up in the blueprints of bipeds. There might, in fact, have appeared on earth many intelligent, hand-using, four-footed animals. So I will lay a small bet that the first men from Outer Space will be neither bipeds nor quadrupeds, but bimanous quadrupedal hexapods. (I have just invented that last word, in the hope that it means "six limbs".)

Finally, will they be big or small? Who will make a nice pet for whom, when we finally meet? Here, of course, gravity would keep weight down. But, on this earth at least, an intelligent animal must not be too small. Its brain—or whatever it operates on—must be absolutely large. And there is no reason to suppose that the basic cells and fibres of the brain could be substantially smaller than the same things here, so there should be no saving of mass. Furthermore, small animals—the active, highly organised kind, like mammals—do not live as long as large ones, not long enough to afford them the luxury of behaviour which is largely uninherited and must be learned very slowly. So other men should not be much less bulky than we are.

Perhaps they should be more so. We have not become bigger, ourselves, as we got brainier, and J. B. S. Haldane pointed out long ago the hazards of being too big. The giants in *Pilgrim's Progress*, or any story-book giants, were amateurishly engineered. Being the same shape as ourselves, they would have collapsed in a heap, with broken thighs; their legs were not big

enough to support their bulk. For, when an animal gets really large, its legs must become disproportionately thick and strong to keep up with its mass, its cubic content. This happens in elephants. Man, as a biped, is probably as big as is safe for him. Bipedal dinosaurs, it is true, got much larger, like *Tyrannosaurus*, but at the cost of being decidedly bottom-heavy, with great haunches and a fat tail. So the men of elsewhere, if bipeds, are probably no giants. But if they have four feet to hold them up, then they might well be as big as a horse, or larger, and

still be both intelligent and manoeuvrable.

So, on the whole, perhaps mankind as represented by ourselves is a pretty good model for intelligent creatures. However, this does not tell us whether we had to happen at all. I have said what a "human" being might be like in other worlds than ours. But what about the chances of men coming into existence again, not elsewhere, but on this very planet? Supposing, in a moment of idiot progress, we really killed ourselves off. Would *Homo* rise again?

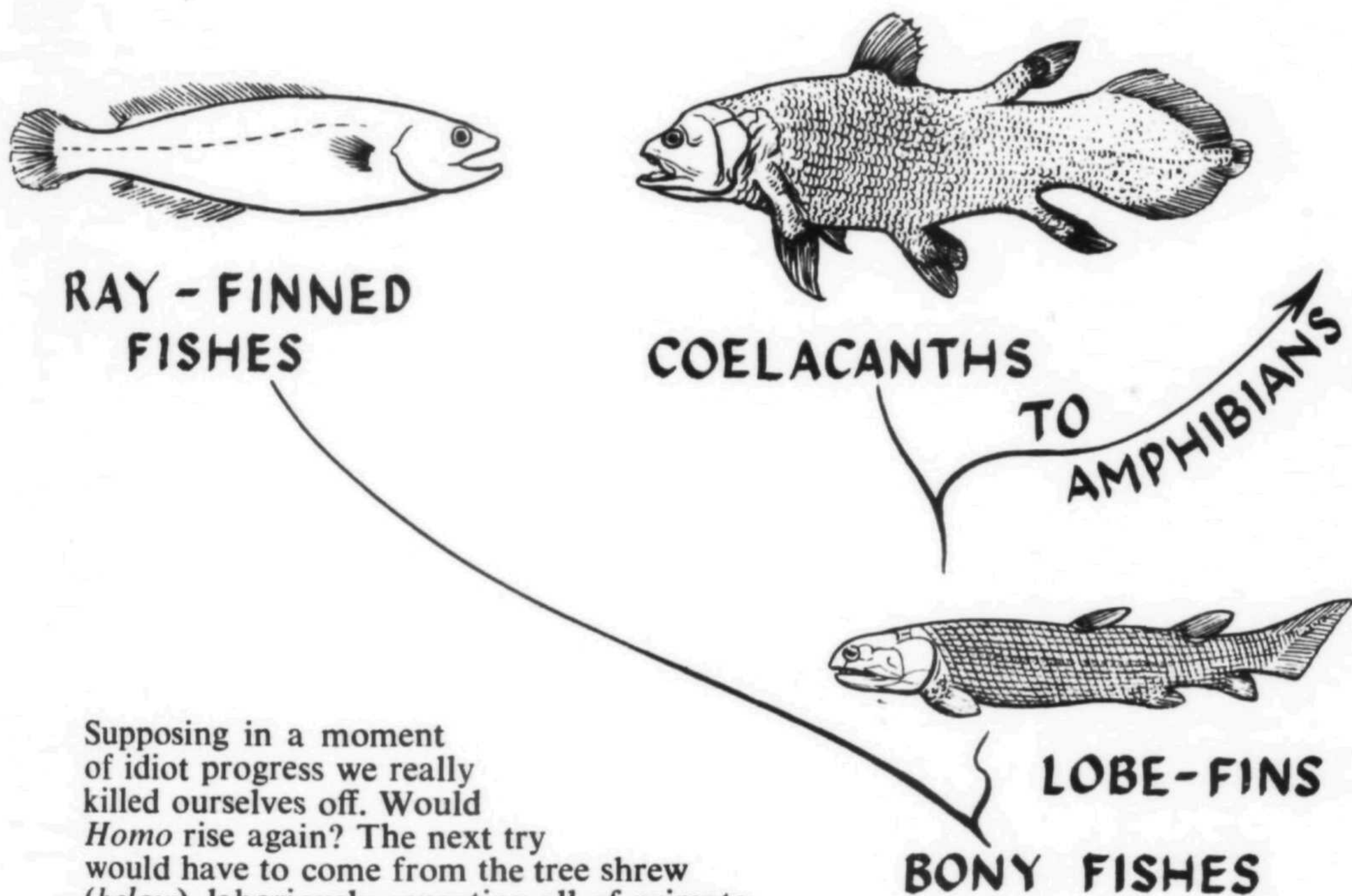
Man came from an australopithecine,

or some simpler hominid, perhaps like *Oreopithecus*. Those animals are gone; man has competed them into the grave. There are still apes. They might do for a fresh start, but I strongly suspect they are too specialised, and too busy looking for fruit in the forest, to turn to freer use of hands. Monkeys? Just possibly, if something made it worthwhile for a species to stand up. The new men might then have tails. But, in fact, the monkeys have made no move to mimic the hominoids, or human ancestors, during about thirty-five million years.

No other higher mammals of this earth will serve. Horses, dogs, elephants, all are deeply committed to being what they are. The next try would have to come from a tree shrew, laboriously repeating all of primate history. And before little *Tupaia* could put forth progressive descendants now, the world would have to be swept clean of the kind of competition which might overwhelm them on the way up. This means: get rid of most higher mammals, above all, rats, cats, and monkeys.

If he fails us, we (or rather our carbon copies) are done for. The remaining links of progress are now missing links; the good chances are gone. The mammal-like reptiles gave out long ago; and getting something human from the specialised creatures in the next ranks is hopeless: birds, snakes, frogs. The fishes? Lobe-fins, with the makings of lungs and limbs, were put out of business eons ago by the ray-fins, who can never leave the sea. The main army of fishes has gone well past the fork that once led to the land. Only the lungfish remain, waiting in mud for the rain to come again, and the coelacanth, so deep in the ocean that he dies in shallow water.

We might need brand-new "vertebrates". Well, then, eradicate the fish, who rule the seas as we rule the land and who are not likely to stand aside while nature experiments with ridiculously crude forerunners of ostracoderms once more. Conceivably life would have to start afresh. In that case, wipe out everything that moves, to keep the necessary simple molecules from being eaten as they form. So all in all our hopes for repetition are not good, and we had better stay the hand that drops the bomb.



Supposing in a moment of idiot progress we really killed ourselves off. Would *Homo* rise again? The next try would have to come from the tree shrew (below), laboriously repeating all of primate history. If he fails us, we (or rather our carbon copies) are done for. The remaining links of progress are now missing links; the good chances are gone. The mammal-like reptiles gave out long ago and getting something from the specialised creatures in the next ranks (birds, snakes, frogs) is hopeless. The fishes? Lobe-fins with the makings of lungs and limbs were put out of business eons ago by the ray-fins (above), who can never leave the sea. The main army of fishes has gone well past the fork that once led to the land. Only the lungfish remain, waiting in mud for the rain to come again, and the coelacanth, so deep in the ocean that he dies in shallow water.

