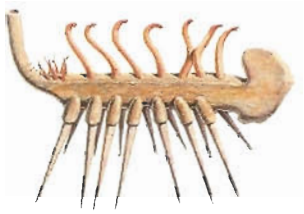
Strange Bedfellows

On a British Columbia mountainside lie preserved the tiny monsters of the Burgess Shale. They are creatures of evolution every bit as unlikely as we are



by Jamie Findlay

It is a Saturday morning in midsummer, and a group of us have assembled at the foot of Mount Wapta, in B.C.'s Yoho National Park, for a guided day hike. We will go up Mount Wapta and then south along the backbone of the continent to a petrified sea. Formerly you could visit this place alone, but there were concerns about people taking things, and now the park authorities ask that you join one of the twice-weekly guided hikes. Today the group consists of a few weekend campers, their kids, a photographer and his wife, and me. It is a perfect morning, green and clear. By noon, keeping a steady pace, we will be back in the days when skeletons had only just entered the world. The palaeontologists up there will be able to show us around.

We wind our way up Mount Wapta, past tiny Yoho Lake, and move out onto the mountainside. The mountains are clear cut and enormous in the sunlight. If you could watch the land take its present shape, in a kind of reverse time-lapse photography, the most violent sculpting would occur before your eyes. Glaciers would move in and clobber the range, gouging out its current profile. After a while you would feel the continent drifting eastward under your feet, and the mountains would dwindle. Not long afterwards you would hear the waters coming in from the distance, and eventually the whole area would be under an ocean. With the ocean would come tiny monsters, most no longer than a few inches. All this would happen over a space of about 500-million years.

On the mountainside ahead those tiny monsters lie petrified, some as perfectly preserved as flies in amber. They are the fossils of the Burgess Shale.

Here I use the word "monster" in its taxonomic sense, to mean a creature forgotten by man and God. Some of the animals of the Burgess Shale have five eyes and long fleshy nozzles; some have the bodies of recumbent Gumbies with tentacles on top and spines below; some have the profiles of squids and the jaws of nutcrackers. Nowhere else in the world can you see so clearly the fantastic shifts and dodges of early evolution. Natural tombs like this – and they are rarer than dinosaur eggs – have a holy status in the eyes of earth scientists. The Harvard palaeontologist Stephen Jay Gould calls the Burgess creatures the most important animal fossils we know, not just because they tell us something about early life but because they tell us something about us. They have a large point to make. And we're still not sure if several are complete monsters, or just monster fragments.

The palaeontologists are waiting on the mountainside, standing beside their tents. They are very dusty. One of them, a student, explains that they stay up at the excavation site for about ten days, then go down to civilization for three days. "And what day are you on?" asks a woman in the group. "The tenth," he ▸

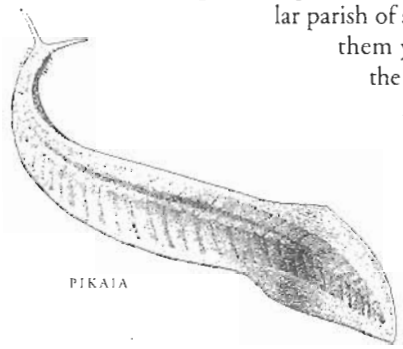
ILLUSTRATIONS OF ANOMALOCARIS (TOP) HALLUCIGENIA (BOTTOM): DENNIS B. BUDGEN

One small ribbon-like animal may be considered our ancestor. Does the emergence of thinking really depend on such a tiny creature?

Burgess Shale

says, grinning, "so don't get too close." They have a tent for cooking, several for sleeping, and one for examining specimens. Their days are spent sifting through the scree above them, moving and splitting rock, looking for odd shapes in the fragments. It must be hard, tedious work, but there is always the possibility of finding some boneless horror intact, with its eyes staring and its tentacles upraised; and there are always the nights, with the stars as loud as lightning. I can think of worse summer jobs.

The palaeontologists are led by Desmond Collins of the Royal Ontario Museum in Toronto, who has been coming up to several sites in the area for the past fifteen years or so. He has some fossils for us to see. Some are nothing more than vague brush strokes in the rock, but some are beautifully articulated creatures, with legs and gills and membranes clearly discernible. Usually the earth preserves only hard animal parts like shells and bones, since tissues tend to decay after death; but through a geological accident the Shale preserves soft parts as well – so beautifully, in fact, that in some specimens you can make out the remains of a meal in the animal's gut. All our great windows on the ancient past are smudged in some places, but the Burgess one is about as flawless as the earth can provide.



PIKAIA

Through this window you can see many things. You can see shapes stalking and scavenging, burrowing and filtering, and shapes drifting like manta rays through the murky green water. You can see that mid-Cambrian life was not simple but extraordinarily variegated, both in its range of anatomies and in its strategies for living. And, says Gould, if you consider the streams that flowed from this great pool of life, you can see that there was nothing inevitable or even likely about our rise. One of the messages of his 1989 book, *Wonderful Life: The Burgess Shale and the Nature of History*, is that Homo sapiens is a "wildly improbable evolutionary event," a spark in the night. "Wind back the tape of life to the early days of the Burgess Shale," he writes, "let it play again from an identical starting point, and the chance becomes vanishingly small that anything like human intelligence would grace the replay."

Now, Gould often finds large lessons in small things – the panda's thumb, the horse's toes, the flamingo's smile – but you may well wonder if he's reading too much into these tiny scribbles in the rock. The Burgess animals are over 500-million years old and as alien as anything on earth. What can they possibly tell us about our emergence?

Up close, not much. But stand back and look at them from our late vantage point on the curve of life, and you will see some of the immense country that lies between them and us. The Burgess animals are as distant, in aeons, as the Crab Nebula, and so well preserved that they light a long way beyond their particular parish of space and time. By them you can make out the shape of early evolution, and a bit of what came later. You can't see much in the way of particulars, but it's the perspective that counts. You get a sense of how long the road has been, how many possibilities lie behind us. And that makes it a lot easier to imagine the world empty of Homo sapiens.

The old joke in palaeontology, Gould tells us, describes mammalian evolution as a tale of teeth mating to produce slightly altered descendent teeth. Bones, shells, teeth – this is all palaeontologists have to go on, and it's not much. If you were to follow back the vertebrate line through the aeons, using only the fossil record as your guide, you would be walking through a lot of empty landscapes. Primates would take to the trees, and then come down as something like large hedgehogs, but you wouldn't see it happen. The dinosaurs would move around on the horizon briefly – their bones are large and relatively numerous – but after this you would slowly enter twilight. The living world would slide out of focus. Shapes would skitter by in the jungles, and dimple the surfaces of pools, but the details of their forms would lie under shadow. As you walked back you would feel the continents drifting together and melding, and off in the darkness life would return to the seas. The moon would grow larger, the days shorter. After you entered the Cambrian period the darkness would be almost complete.

Then you would come to the Burgess Shale, where the seas of the past would be lit up like a public aquarium.

Before you would be a marine reef as it was about 530-million years ago. You would see tiny flecks of flesh with multiple eyes, worms with tentacles and bristles, a caterpillar-like thing crawling about on sponges, something large that swam like a manta ray but was not a manta ray. You might see round armoured animals called trilobites, among the commonest fossils from the Cambrian. (Bones have not yet made their appearance, but a number of animals here have the first kinds of skeletons – shells and "spiny skins" such as those of present-day sea urchins.) You might see a spiked, plated walnut shell crawling across the sea bottom, its plates arranged like shingles on a roof, and a creature that looked like a combination of a water strider and a crab.

If any era might be considered the cradle of life, this is it. Nothing in the rocks before the time of the Burgess Shale matches the wild efflorescence that marked the mid-Cambrian. Not only is the Shale a relatively clean window, but it looks out on a particularly riotous and uninhibited time in evolution.

Needless to say, this world is not only

ILLUSTRATION: STEPHEN JAY GOULD

it is the last word in the ability to process information. Might not evolution have just wended its way naturally towards a thinking being?

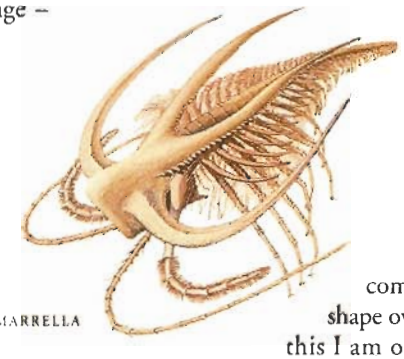
Ahead looms a juncture that is particularly important in this respect. It is the death of the dinosaurs. Again, something catastrophic probably happened here, for many other organisms became extinct along with the dinosaurs. Gould is particularly interested in this episode, for he believes it was crucial to our own emergence. If the dinosaurs had not died out, he argues, mammals would not have been able to find a niche. And that would have snuffed out any prospect for mind. "Since dinosaurs were not moving toward markedly larger brains," he writes, "and since such a prospect may lie outside the capabilities of reptilian design . . . we must assume that consciousness would not have evolved on our planet if a cosmic catastrophe had not claimed the dinosaurs as victims."

Here in the late Cretaceous period is an opportunity (so you think) to test this assumption. Small svelte dinosaurs are scuttling by on their hind legs, dinosaurs that seem to have eyes in the front of their heads and the beginnings of opposable thumbs. They look promising. Could they have evolved into some kind of self-conscious intelligence if they had not become extinct? Who knows? The fossil record has nothing to tell us about alternative histories. It barely has anything to tell us about *actual* histories. All you can say is that these creatures disappeared relatively quickly – and you are still not sure of the reason even as you stride into the age of mammals.

OTTOIA

Nobody knows what would have happened if the dinosaurs had not become extinct. Nobody knows if some sort of mind could have arisen in a different stream from the mammalian one. What we do know is that 10,000 things went into the making of a *human* intelligence, and this suggests that its particular character is somewhat rare. The recipe for a remembering, language-using, technology-haunted, self-conscious creature seems to involve a fairly precise chunk of history. The chances of that history repeating itself, in this or another world, are pretty small.

As you walk forward into the recent geological past you can see some of the elements that went into the making of humans. You see a four-foot missing link scampering upright near a forest. You see *Homo habilis* fashioning tools on the African savanna. After a while you start to hear language – real language, not just gibbering and gruntings. You watch the emergence of an increasingly complex social life. From the change in human physiognomy you get a sense of the anatomical alterations that went hand in hand with these developments, including the increase in brain size and the lateralization of functions. You see imagery flowering in the form of cave paintings and religious rituals. Finally you make your way down the spine of the Rockies to the Burgess quarry, where the palaeontologists – in their modern hominid form – are sipping tea in their lawn chairs. It has taken you barely a few minutes to go from the earliest primate to these most recent ones.



MARRELLA

Now you know a bit of the story behind this story. Homo sapiens is an evolutionary parcel. Its skeleton, brain, and social life evolved together. Without this history, this run of circumstances, its intelligence would not have appeared in the form that it did. Whether it would have appeared at all is anyone's guess.

Gould is right in at least one respect: you can see a lot from the Burgess quarry. Few other geological eyries give you such a strong sense of the variety, the range of possibilities, out of which we took our rise. Normally we forget all about this. We look back and see a line from the most primitive vertebrates to us, and if we squint in a certain way, that line seems to assume a certain ineluctability. History rolls back to make way for our tribe. But there were alternative routes back there, at almost every juncture. There were various soft-bodied forms, and various nervous systems, and various packages of brain and bone, that might have triumphed in more favourable settings. What emerged was the cumulative work of circumstance. One thing led to another, and that to another, and so on down the ages; and the end product in all its permutations was unlikely from the start. In this sense, we are improbable creatures – improbable as falcons or newts or any other complex animal that took shape over the aeons. In saying this I am only summarizing the observations of many eminent biologists.

It is hard to say whether we as thinking beings are a *complete* fluke, however. Granted, if you wound back the tape of life and let it run again, you wouldn't get Homo sapiens. You might not get falcons either. But you might very well get something with wings, and you might well get something vaguely like us, something intelligent.

It's not the sort of question you can answer on the basis of rocks. All you can say is that we are a cosmic rarity for the good reason that a certain stretch of history went into our making. Since that history is bound to be different on another planet, intelligent extraterrestrials – if they exist – are going to look mighty different from humans. We might not even recognize them as intelligent. They might have some reservations about us. But in both cases, we will be able to trace the peculiarities of our forms and intellects back a long way, through the vicissitudes and fortunes of our respective planets.

On the basis of all this, you can call yourself unique if you want. There is certainly nothing else around you with your particular form, your brain, the precise cut of your skeleton. But there is also nothing else around with the leg-iron jaws of those luminous deep-sea fishes, and nothing else around that literally pulls itself apart like the sea star, and nothing else around that looks quite so much like seaweed as the sea dragon. These monsters, like the Burgess ones, draw our eyes to the periphery of the world, the way shooting stars do. Even a glimpse of one is enough to leave us with an enlarged sense of space. SN

ILLUSTRATIONS: DENNIS B. BUDGEN