and extending throughout the realm of the sovereign power. In the seventeenth century, the metaphor was quite explicit: the laws of nature were framed by God, the Lord of all Creation. His laws were immutable; his writ ran everywhere and always.

Although many people no longer believe in such a God, his universal laws have survived him to this day. But when we pause to consider the nature of these laws, they rapidly become mysterious. They govern matter and motion, but they are not themselves material nor do they move. They cannot be seen or weighed or touched; they lie beyond the realm of sense experience. They are potentially present everywhere and always. They have no physical source or origin. Indeed, even in the absence of God, they still share many of his traditional attributes. They are omnipresent, immutable, universal, and self-subsistent. Nothing can be hidden from them, nor lie beyond their power.

Eternal laws made sense when they were ideas within the mind of God, as they were for the founding fathers of modern science. They still seemed to make sense when they governed an eternal universe from which God's mind had been dissolved. But do they any longer make sense in the context of the Big Bang and an evolving universe?

When we look again at the source of the legal metaphor, to human legal systems, we see at once that *real* laws do indeed develop and evolve. In the English tradition, the common law that governs so much of our lives has grown up over many centuries, rooted in ancestral customs and judicial precedents, continually developing as circumstances change and as new situations arise. And in all countries, new laws are enacted and old ones modified or repealed by the powers that be. Constitutional governments are themselves subject to legal constitutions, which likewise change and evolve. And from time to time, old constitutions are overturned by revolutions and replaced by new ones, drawn up by constitution-makers. We apply this idea to science itself in the metaphor of scientific revolutions. They establish new scientific constitutions, within which scientific laws are framed.

If we are to persist with the legal metaphor, it might be appropriate to suppose that the evolving natural world is governed by a system of natural common law, rather than by a preformed legal system established at the outset, like a universal Napoleonic code.

But then who or what corresponds to the judicial system that establishes the precedents? And who or what framed the constitution of the Big Bang in the first place? And by what power or authority are they maintained? These questions arise inevitably, because they are implicit in the metaphor of law. Laws imply lawgivers, and they are maintained by the power of authority. If we drop the idea that the laws of nature are framed and maintained by God, then we must ask: what makes them up and how are they sustained?

Many philosophers would deny that these questions have any meaning. From the point of view of the empiricist tradition, what we call the laws of nature are in fact human concepts that merely refer to regularities which scientists observe, describe, and model. They have no real, objective existence. They are theories and hypotheses in human minds.[16] So there is no point in asking how they arose as objective realities or by what power they are maintained.

But then what about the observable regularities that these laws refer to? What is the basis of the regularities of nature? They cannot depend on natural laws if these laws are only in human minds. And there is no basis for assuming that these regularities are eternal. The regularities within an evolving universe evolve: this is what evolution means.

The Growth of Habits

If the evolving regularities of nature are not governed by transcendent laws, then could they not be more like habits? Habits develop over time; they depend on what has happened before and on how often it has happened. They are not all given in advance by eternal laws which are quite independent of anything that actually happens—and even independent of the existence of the universe. Habits develop *within* nature; they are not imposed on the world ready-made. Sugar crystals, for example, may form in the way they do now because countless sugar crystals have already formed that way before.

This general possibility—the possibility that the regularities of nature are more like habits than products of transcendent laws—is what this book explores. This exploration takes place in the context of a specific, scientifically testable hypothesis, the hypothesis of formative causation. This hypothesis is described in chapter 6 and subsequent chapters. But the general idea that nature is habitual is by no means new: it has been tried out before, and was indeed widely discussed towards the end of the last century and at the beginning of this one. But the wave of interest in this idea ebbed after World War I. It went out of fashion and sank into obscurity. Why?

The idea of the habits of nature was conceived of in an evolutionary spirit, rather than under the aspect of a theoretical eternity. For example, about a century ago the American philosopher C. S. Peirce pointed out that the idea of fixed and changeless laws imposed upon the universe from the start is inconsistent with a thoroughgoing evolutionary philosophy. Rather, he thought, the "laws of nature" are more like *habits*. The tendency to form habits grows spontaneously, as follows: "Its first germs arose from pure chance. There were slight tendencies to obey rules that had been followed, and these tendencies were rules which were more and more obeyed by their own action."[17]

Peirce considered that "the law of habit is the law of mind" and concluded that the growing cosmos is alive. "Matter is merely mind deadened by the development of habit to the point where the breaking up of these habits is very difficult."[18]

The German philosopher Friedrich Nietzsche, writing around the same time, went so far as to suggest that the "laws of nature" not only evolved, but underwent some sort of natural selection:

> At the beginning of things we may have to assume, as the most general form of existence, a world which was not yet mechanical, which was outside all mechanical laws, although having access to them. Thus the origin of the mechanical world would be a lawless game which would ultimately acquire such consistency as the organic laws seem to have now. . . . All our mechanical laws would not be eternal, but evolved, and would have survived innumerable alternative mechanical laws.[19]

And somewhat later William James wrote in a vein similar to Peirce:

> If . . . one takes the theory of evolution radically, one ought to apply it not only to the rock-strata, the animals and plants, but to the stars, to the chemical elements, and to the laws of nature. There must have been a far-off antiquity, one is then tempted to suppose, when things were really chaotic. Little by little, out of all the haphazard possibilities of that time, a few connected things and habits arose, and the rudiments of regular performance began.[20]

Other philosophers towards the end of the last century and at the beginning of this advocated similar ideas,[21] but then this entire line of thought more or less fizzled out. Physicists held firm to the idea of an eternal universe governed by eternal laws; and indeed this idea gained a new lease of life through Einstein's general theory of relativity. Einstein postulated not a relative but an absolute, eternal universe. Events within this universe were relative to each other; but the background reality was changeless. We should remind ourselves again that it was not until the 1960s that an evolutionary cosmology became predominant in physics.

The idea of habit was also explored in the realm of biology. Living organisms seem to have within themselves a kind of memory. Embryos develop in ways that repeat the development of their ancestors. Animals have instincts that seem to embody ancestral experience. And all animals can learn; they build up habits of their own. All this was pointed out with admirable clarity over a hundred years ago by Samuel Butler. Memory, he concluded in *Life and Habit,* is the fundamental characteristic of life: "Life is that property of matter whereby it can remember—matter which can remember is living. Matter which cannot remember is dead." Two years later, in *Unconscious Memory,* he went even further: "I can conceive of no matter which is not able to remember a little, and which is not living in respect of what it can remember. I do not see how action of any kind is conceivable without the supposition that every atom retains a memory of certain antecedents."[22]

As embryos develop they pass through stages that recall the embryonic forms of remote ancestral types; in some way the development of an individual organism seems to be related to the entire evolutionary process that gave rise to it. Human embryos, for example, pass through a fishlike stage with gill slits (Fig. 1.1). Butler saw in this a manifestation of the organism's memory of its own past history. "The small, structureless, impregnate ovum from which we have each of us sprung, has a potential recollection of all that has happened to each one of its ancestors."[23]

Such ideas were widely discussed by biologists until about the 1920s,[24] and the theory that "heredity is a form of unconscious organic memory"[25] was worked out in considerable detail.[26] But by then the development of genetics seemed to have shown that heredity could be explained in terms of genes, made up of complex molecules. The genetic material is now known to consist of DNA. The memory of which Butler and others spoke appeared to be embodied in inanimate matter after all and to be produced mechanistically. The notion of inherited habits of form and behaviour dropped out of biology.

However, as we will see in chapters 4 to 8, in spite of all the successes of genetics, molecular biology, neurophysiology, and so on, biologists have still not managed to explain the development of embryos or the inheritance of instincts in mechanistic terms. Chemical genes and the synthesis of specific proteins certainly have something to do with it; but how does the inheritance of a certain set of chemical genes and the synthesis of certain proteins make swallows, for example, migrate from a certain part of England to southern Africa before the English winter begins, and then make the birds migrate back to the same place in England in the spring? No one knows. No one knows how embryos progressively take up their forms or how instincts are inherited or how habits develop or how memories work. And, of course, the nature of minds is obscure.

In short, all these aspects of life are still mysterious. Many biologists believe that in due course they will cease to be so because they will all be

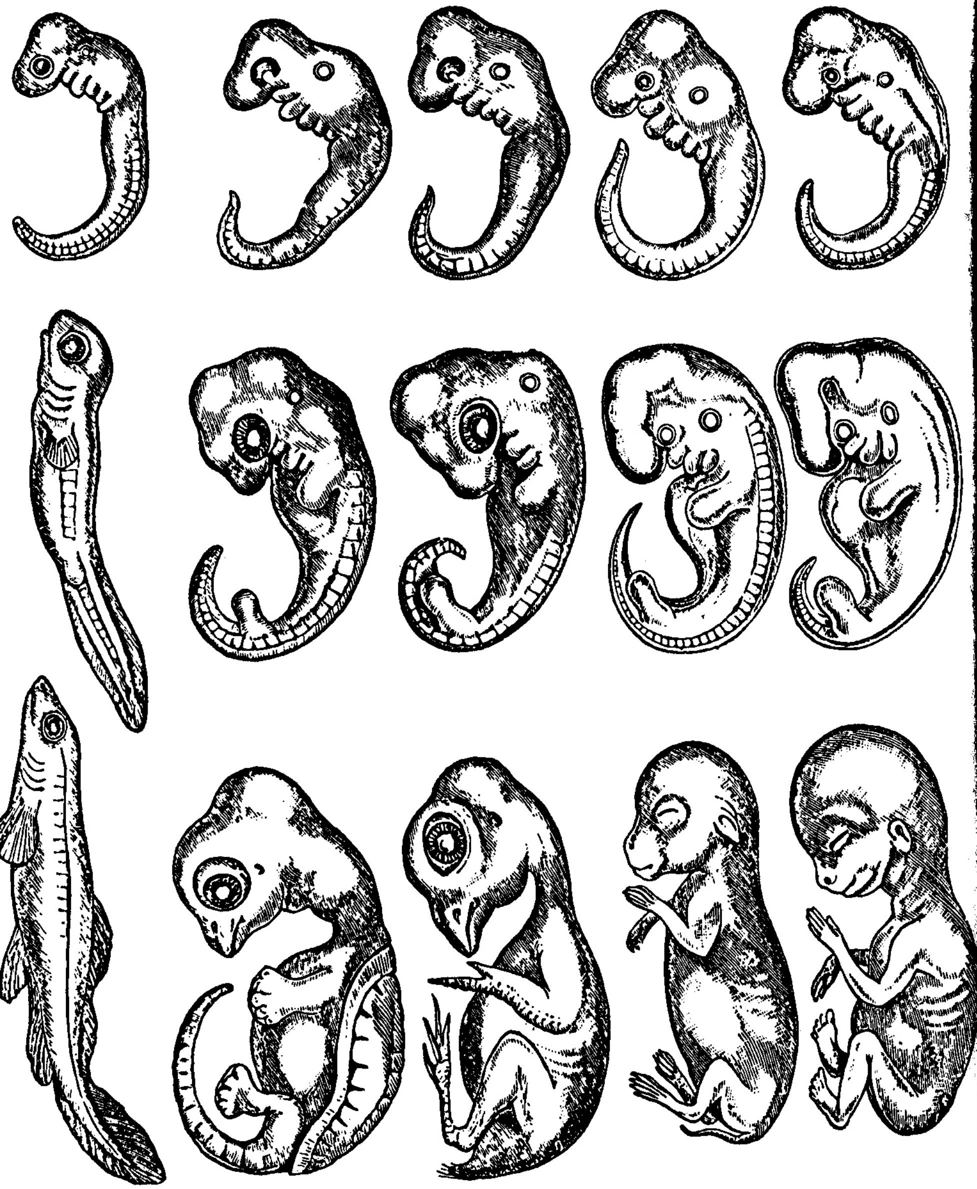

Figure 1.1 The embryonic development of five species of vertebrates, illustrating the striking similarities at the early stages of development. Note the embryonic gill slits between the eye and forelimb. (After Haeckel, 1892)

explained mechanistically. That is to say, they will be interpreted in terms of physical and chemical models, and hence will ultimately be accounted for in terms of the eternal properties of matter, fields, and energy. As conventionally conceived of, this process would not involve invoking mysterious non-material memories or fields which evolve in time, but rather would rely on the assumption of eternal laws of nature transcending time and space.

The vision of eternity which has inspired the theories of physics for many centuries remains a powerful force, and to understand why we have to consider its history. We do so in the next chapter; and then in chapter 3 we turn again to the evolutionary vision of reality, a vision which is still growing and extending its scope, and which is proving itself to be more powerful than the vision of a physical eternity—even in the heart of theoretical physics.

typewriter before. The rate at which they learn to type on a standard QWERTY keyboard would be compared with the rate on a machine on which the keys were laid out in a different way. If the students learned quicker with the QWERTY keyboard, this would suggest that their learning was being facilitated by morphic resonance from typists in the West.

In the Western world, the reverse of this experiment could be carried out with students of Russian (or Greek or Hindi) who are familiar with the relevant alphabet but who have not previously been exposed to typewriters using this alphabet. In such an experiment, the rate of learning to type with, say, a standard Russian keyboard would be compared with the rate with a different layout, designed to be of comparable difficulty according to conventional theories. The hypothesis of formative causation would predict that the standard layout should be easier to learn, just because so many people in Russia have already learned it.

This experiment could be done quite easily using suitably programmed microcomputers whose keys were labelled with the appropriate patterns of Russian letters. A standardized learning procedure could also be programmed into the computer and the rate of learning recorded automatically.

These examples, only a few of the many conceivable ways in which the hypothesis of formative causation could be tested in the realm of human psychology, serve to illustrate that such experiments are not only feasible but can be carried out with facilities and equipment that are readily available in most university psychology departments and even in many secondary schools.

In this chapter we have explored the possibility that our learning of language and of physical and mental skills is facilitated by morphic resonance from many other people who have already learned them. Several experiments have been carried out to test for this effect, with results that are consistent with the hypothesis of formative causation. If further experiments provide a convincing weight of evidence in favour of this hypothesis, this new understanding could have far-ranging implications for education and training. For example, it might be possible to develop new methods of teaching that maximize the facilitation of learning by morphic resonance.

We now consider the role that morphic resonance may play in our own personal memories.

CHAPTER 11

Remembering and Forgetting

We can remember people, places, tunes, words, ideas, stories, events, and a host of other things. We usually take all this for granted and don't need to ask how our memories work.

The conventional theory is, of course, that everything we can remember is somehow stored inside our brains in the form of material patterns, the memory traces: there are such material patterns in our brains for every tune we know, for everyone we can recognize, for every word in our vocabulary, for every event we can recall—a myriad of memory traces for everything we are capable of remembering.

But this is just a speculative theory. No one has ever seen a memory trace; and scientists who have looked for such traces have so far failed to find them.

In this chapter I explore the alternative possibility that memories are *not* stored inside the brain. The spatio-temporal patterns we remember may not be inscribed in the brain in the form of material traces but may depend instead on morphic fields. The morphic fields through which our experience, behaviour, and mental activity were organized in the past can become present again by morphic resonance. We remember because of this resonance from ourselves in the past.

I first discuss the morphic fields of behaviour and of mental activity, and the general role of morphic resonance in memory. I then consider one of the essential preconditions for conscious memory: awareness. In general, we cannot remember something if we were not aware of it in the first place; and awareness arises against a background of unawareness, owing to habituation, which itself depends on morphic resonance. I go on to consider the role