

## *Preface*

WHEN I WAS VERY YOUNG the certainty of the physical sciences appealed to me. Mendeleev's periodic table showed how elegantly the elements repeated a simple pattern as atoms added electrons one at a time. Newton's laws of motion were as exact as the theorems in my first intellectual love, plane geometry. Little did I know.

Of course, my teachers didn't know either. "In 1927," when I was in third grade, "Heisenberg invented his uncertainty relations, which put the cap on the great scientific revolution we call quantum theory," Leon Lederman wrote in his splendid account of particle physics from Democritus and earlier to 1993 (*The God Particle* [Boston: Houghton Mifflin, 1993], 175). Came the revolution, and one thing physicists are certain of now is, in a word, uncertainty.

The macro-universe Isaac Newton described in the seventeenth century, the universe we live in, still works as Newton said it did. But inside an atom's nucleus, it's a whole new ball game, and the ball in that game, the electron, has no mass and a radius measured in 1990 at "*less than .00000000000000001 inches*" (Lederman, 142). In that hard-to-imagine world, physicists find they cannot be certain, only approximate.

Some of this uncertainty seems to leak back into our normal world. Meteorologists know pretty well at what temperature moisture in the air can condense into droplets and fall as rain, but they can't tell us how

much rain will fall at what time in any given place. So they resort to averages, statistics, like “The chance of rain on Thursday is 40 percent.” Meteorologists keep trying to predict weather more precisely, but physicists know there is much they cannot be precise about. If they can detect the velocity of an electron or other particle they cannot know its location, and vice versa.

Government agencies have been exercised recently over the year 2000 census. They ask: should everyone be counted, or would equally good or better information come from sampling and statistics? No doubt a compromise will be worked out, but in particle physics there can be no exact count.

Suppose a census taker was assigned to a very odd community; its transients are becoming residents and residents becoming transient. Where they come from and where they go they don’t tell even if they know. Any one of them may stay a day or two or a week or even less than an hour, or perhaps never leave, and even when they are “in the community,” they may or not be in the house when the census taker calls. I don’t pretend to understand quantum theory, but it seems to me what goes on in inner space may be something like life in this imagined community.

Leon Lederman’s book is so fascinating and readable that I am giving it to my teenage grandson. He may be a little young for it, but he is good at mathematics, and at his age a little mind stretching won’t hurt a bit. Lederman focuses attention on each genius who moved physics forward, but amazingly, he keeps coming back to the truth of what Democritus said twenty-four hundred years ago: “Everything existing in the universe is the fruit of chance and necessity” (59).

## What about Language?

If Democritus had it right, language, which exists in the universe, also has to be the fruit of chance and necessity. Necessity? Yes—anything anyone says must have some regularity to it. If not, we wouldn’t understand a word of it. Not surprisingly, a scholar named Pānini, almost at the same time as Democritus but farther east in India, was finding

necessity, or necessary regularity, in the Sanskrit language. He may not have realized it, but in doing that he became the world's first grammarian.

Since Pānini, for two and a half millennia, grammarians have been concentrating on necessity—the necessary regularity of pattern or structure in what people say (usually after it has been written down). Grammarians discover patterns, or rules. And the rules, some of them say, determine the whole structure of language, with the full force of necessity—world without end, amen. And yet, what anyone actually does say or will say is hardly more predictable than the weather or the position and velocity of an electron. Democritus said “chance *and* necessity.” We may not have as much to say about chance in language, and there is even less that we can do about it, but necessity is only part of the story.

I'm long out of third grade and high school physics, so I'm not infallible any more, but I think that a great deal of nonsense has been written and believed about language because grammarians get mixed up about necessity. They mistake what is sufficient for what is necessary. The proof of this proposition does not need quantum theory, just basic logic and a fact: speech is sufficient for language, but not necessary.

Granted, 99.9 percent of us use speech for language, and many cannot conceive of language any other way; yet millions of people who cannot hear make up the other 0.1 percent. They use languages of visible, not audible, signs. Because deaf people have and use signed languages, we must conclude that either speech or signing is sufficient for language and that neither by itself is necessary.

Then, just what about language does necessity rule, and where does chance come into it? We cannot go back to physicists for an answer to this one. Or perhaps we can. From physical laws and theories came the basis of the knowledge chemists have gained about the composition of things. Chemists' findings enable biologists to understand anatomy, physiology, and genetics. Biologists guided by Darwin and many after him can tell us a great deal about chance and necessity.

## Evolution

About five million years ago, some apes came down out of trees and lived in new ways. Some of them must have differed—by chance, what else?—

from their relatives left up there. Among the new breed too there must have been differences. There always are. These differences, one way or another, resulted in more of the odd ones' offspring surviving. Given long enough, a new species that walked upright and was not as well adapted as the old for living in trees evolved. This origin of a new species happened more than once in those few million years. Fossils show that *Australopithecines* and a few species of genus *Homo* originated and became extinct (or evolved into others) in that long period. At the same time, however, gorillas, chimpanzees, and orangutans continued pretty much unchanged. Apparently they differed or departed less from our remote common ancestor's physical form and way of behaving.

Necessity sees to it that parents' genes largely determine their offspring's physical form. And physical form necessarily influences behavior, what can be done and how. Chance has already entered as variation, as every parent knows who has two or more children (not identical twins). Siblings differ in many ways. Multiply that by the variation within offspring in one generation of a whole population or species and it's clear that chance has ample room to work, generation after generation.

No question then. Necessity and chance, in the form of natural selection, produced the human species. We're here, but so is language. And language is not physiology—or is it? Because language cannot be weighed or measured or even directly tied to the events we suppose it may have caused, some philosophers in every age have thought that language is separate from our bodies and everything else physical. Yet no evidence can be found for the separate existence of mind, spirit, soul, language, thought, concepts, and so on. They belong to us, inhabitants of this physical universe. Evidence keeps turning up that human brains, vision, hearing, and actions not only suffice but must be there for language. Necessity again. Language must have the human species, with all its chance or random variation, to operate in and on.

But note well that none of this had to happen. Chance brought it about. No necessity forced some apes to come out of the trees five million years ago. Necessity did not force some of their descendants to evolve into apemen and humans. Chance, not necessity, determined that some of the population happened to look at the world and each other a little differently and act differently.

But even with differences enough to evolve into various human species, the whole hominid line remains very similar in one way to the ancestral strain. From chimpanzees to the girl next door, we primates communicate, we live *socially*. Good thing, too. The infant anthropoid ape is helpless and needs maternal care for many months. How long does a human infant and child remain dependent? We haven't really determined yet how much and what kind of care for how long one needs to become fully human.

Whether we are communicating as well as we should with our children, communication is as necessary for social life as oxygen is for physical life. And ever since there were social species, chance has had plenty of scope to select the kind of communication that social species need. In some species, chemical signs are produced and interpreted. Scent continues to keep many social mammals identified and connected. Virtually all social animals, including those that may be prey or predator, also interpret sounds and what they see others doing. Above all, literally, are the songs and calls that birds make and hear and interpret.

And then there is language, the uniquely human system—which some will tell you is special and exempt from the necessity and chance governing the rest of life. If you believe that, I have a little invention here I'd like to sell you. A few drops of it in your car's tank and you'll never have to fill up with gas again.

Of course, chance and necessity rule a language. Democritus was speaking of the whole universe and *everything* in it, no exemptions, no exceptions. Let's look again at the evolutionary trail. Our hands and apes' hands are homologues, but ours are differently proportioned; we have more nerves and more freedom in several joints—actually all the way from shoulders to fingertips. We can do many, many different kinds of things with our hands. Some of these things apes have no reason to do, but others they can't possibly do because their anatomy has not evolved as human anatomy has.

So we are like other primates and yet we differ from them. Can we speak of behavioral "homologues" as well? Why not? Just like other primates, humans communicate mainly via sight and hearing. Could it be then that natural selection—chance and necessity—enabled language to evolve from some form of communication that came before?

To go back a bit, we can reexamine our fact-based conclusion: speech and signing are each sufficient for language, and therefore neither by itself is necessary. Careful observation tells us that this is true as things stand at the present time. Humans either speak or sign their languages. And some Australian and Native American tribes still have and use both a signed and a spoken language. But would this always have been so? Or ask the question in another way: Would either speech or signing (gesture-like movements) have sufficed to *begin* language? Try first to imagine who could possibly have told the first speakers what the sounds they produced were supposed to mean.

In many different times and places long ago, leading thinkers must have tried to imagine this; for they have left us great stories. They tell of how a god from heaven or a spirit from the deep in the sea or a sacred animal from the forest or a voice from the whirlwind spoke to the first people, endowing them too with speech, telling them the names of things—sometimes giving them very strict dos and don'ts as well.

Other thinkers have steered away from myth and come up with other suggestions about how language—as speech—might have begun. The “bowwow theory” says the first word for *dog* was an imitation of its bark, and so on and on as far as convenient sound sources like that go. The “yo-heave-ho theory” says the word *heave*, or something like it, might have been unintentionally squeezed out as the first speakers strained at heavy weights. Others make lists of words that show sound symbolism.

All these are valiant attempts to explain only the semantics of speech—how a spoken word might have come to mean what it means in the very first place. But none of them can, nor try to, explain syntax—the way language expresses word meanings *and also the meaning of meanings somehow related and interconnected*. These myths fail to notice that as “the fruit of necessity and chance,” language grows singly and in clusters, as words and at the same time as sentences. Simply stated, language includes syntax as well as semantics.

Syntax did not need to be elaborate or complicated to begin with, as a simple thought experiment will make clear. Picture this situation: a third person sees you and a companion together, leaves for a moment, returns, and shows surprise at seeing you alone. You immediately interpret that show of surprise and make a gesture. Little imagination is needed

for what you did and what it means. The gesture said, “She went that way.” But your gesture literally tells that third person more than this translation does. The gesture shows which way she went; the words of the translation do not really mean anything unless spoken with a pointing gesture (reading the words, you do not know which way she went). In the imagined setting, your hand pointed out the direction of your companion’s departure, but your hand also stands for her, the one who departed. The gesture also has or contains syntax because the hand for the person and its movement telling what she did are subject and predicate (or noun phrase [NP] + verb phrase [VP]). Without any speech at all, this experiment demonstrates that gesture is sufficient to *initiate* syntax. Could anything spoken do that? As it has been seventy-two or seventy-three years since I was in third grade, I am afraid I cannot wait until someone can answer that question affirmatively.

The first six chapters of this book will take up these matters in more detail, bringing in evidence when it can be found that evolution proceeded (by chance and necessity) from gesture to language. Chapter 7 continues by showing how gestured language might have led to speech. Once a language had taken hold—a lucky chance for us if there ever was one—handshapes represented people and animals and things (the contents of the visible world) and movements represented actions and changes (observed and reflected on). Together, they did not represent sentences—*they were sentences*. The key to this development is that only gesture use could have initiated syntax, a necessary feature of language.

Eminently useful in the struggle for survival, signs of all kinds have served every kind of animal. But when visible signs easily produced and interpreted contained both word and sentence meanings, the whole potential of language would have been contained in them. The species that began to use gestures in this syntactic-semantic way, whether it was *Homo erectus* or *Homo sapiens*, really began the human story.

Nothing about this early visible language would have prevented its users from making various vocal sounds as they communicated. We are prone to think of language exchanges as spoken. Most are, to be sure; but the fact is gestures accompany most of them, along with other visible changes in the speaker. Few linguists now take any notice of these visible changes, but all of us speakers, when important matters must be

discussed, prefer a face-to-face to a telephone discussion. We know that what we can see contains information we do not want to miss. Chapter 8 focuses on the eventual shift from primarily gestural expression of language with vocal accompaniment to primarily vocal production of language with gestural accompaniment.

Spoken language communication, it seems, is usually accompanied by visible behavior. We can easily imagine the converse: when sign language communication dominated, signers would have made and heard vocal sounds, and these would have contained information too. If this was the case, certain sounds would come in time to be used with certain portions of the signed utterances—just as in spoken language communities certain gestures occur regularly with certain spoken expressions (e.g., “I don’t know,” “no,” “maybe”). The incidental sounds would thus carry more information. Then, just as a gesture nowadays can express, without any speech at all, such meanings as those in the example, so the sounds of long ago could have expressed the meanings even if the associated gestures weren’t made or seen. This state of affairs—that either the gestural expression or the vocal expression serves for normal conversation—actually exists among some tribal peoples who keep to the old ways (see chapter 9). The relationship of speech to gesture and signed languages in various contemporary cultures is explored in chapter 10.

Chance and necessity, gesture-to-language-to-speech—these do not call for just a new way of looking at language. They suggest that we as a species, and as a literate society, could do better than we now do, both in rearing all our children, educating deaf children, and relating to deaf adults.



At this point I depart from the custom of making acknowledgments. In the first place, my present opinions and beliefs have been influenced by too many to name, virtually all who have been close to me, as far back as a great-grandmother. I like to think I inherited some of her spirit. She needed more embroidery floss one day when the menfolk were away, but she didn’t want to wait. Looking at the Model-T standing in the driveway, she told her daughter-in-law, “If you help me push it out to the hill, Mary, I think I can pedal it down.” No thought about driving it



into town or getting it back up that hill, that formidable ess-curving hill that even my father's 1925 Dodge coupe sometimes couldn't climb in low gear! Some of the ideas here are similarly outrageous and will annoy many, so it's better to keep the blame to myself. And of course, like Leon Lederman, many another whose words and ideas I lean on heavily will be identified as I do.