The Music of This Sphere

It is one of our problems that as we become crowded together, the sounds we make to each other, in our increasingly complex communication systems, become more random-sounding, accidental or incidental, and we have trouble selecting meaningful signals out of the noise. One reason is, of course, that we do not seem able to restrict our communication to information-bearing, relevant signals. Given any new technology for transmitting information, we seem bound to use it for great quantities of small talk. We are only saved by music from being overwhelmed by nonsense.

It is a marginal comfort to know that the relatively new science of bioacoustics must deal with similar problems in the sounds made by other animals to each other. No matter what sound-making device is placed at their disposal, creatures in general do a great deal of gabbling, and it requires long patience and observation to edit out the parts lacking syntax and sense. Light social conversation, designed to keep the party going, prevails. Nature abhors a long silence.

Somewhere, underlying all the other signals, is a continual music. Termites make percussive sounds to each other by beating their heads against the floor in the dark, resonating corridors of their nests. The sound has been described as resembling, to the human ear, sand falling on paper, but spectrographic analysis of sound records has recently revealed a high degree of organization in the drum-

ming; the beats occur in regular, rhythmic phrases, differing in duration, like notes for a tympani section.

From time to time, certain termites make a convulsive movement of their mandibles to produce a loud, high-pitched clicking sound, audible ten meters off. So much effort goes into this one note that it must have urgent meaning, at least to the sender. He cannot make it without such a wrench that he is flung one or two centimeters into the air by the recoil.

There is obvious hazard in trying to assign a particular meaning to this special kind of sound, and problems like this exist throughout the field of bioacoustics. One can imagine a woolly-minded Visitor from Outer Space, interested in human beings, discerning on his spectrograph the click of that golf ball on the surface of the moon, and trying to account for it as a call of warning (unlikely), a signal of mating (out of the question), or an announcement of territory (could be).

Bats are obliged to make sounds almost ceaselessly, to sense, by sonar, all the objects in their surroundings. They can spot with accuracy, on the wing, small insects, and they will home onto things they like with infallibility and speed. With such a system for the equivalent of glancing around, they must live in a world of ultrasonic bat-sound, most of it with an industrial, machinery sound. Still, they communicate with each other as well, by clicks and high-pitched greetings. Moreover, they have been heard to produce, while hanging at rest upside down in the depths of woods, strange, solitary, and lovely bell-like notes.

Almost anything that an animal can employ to make a sound is put to use. Drumming, created by beating the feet, is used by prairie hens, rabbits, and mice; the head is banged by woodpeckers and certain other birds; the males of death-watch beetles make a rapid ticking sound by percussion of a protuberance on the abdomen against the ground; a faint

but audible ticking is made by the tiny beetle *Lepinotus inquilinus,* which is less than two millimeters in length. Fish make sounds by clicking their teeth, blowing air, and drumming with special muscles against tuned inflated air bladders. Solid structures are set to vibrating by toothed bows in crustaceans and insects. The proboscis of the death's-head hawk moth is used as a kind of reed instrument, blown through to make high-pitched, reedy notes.

Gorillas beat their chests for certain kinds of discourse. Animals with loose skeletons rattle them, or, like rattlesnakes, get sounds from externally placed structures. Turtles, alligators, crocodiles, and even snakes make various more or less vocal sounds. Leeches have been heard to tap rhythmically on leaves, engaging the attention of other leeches, which tap back, in synchrony. Even earthworms make sounds, faint staccato notes in regular clusters. Toads sing to each other, and their friends sing back in antiphony.

Birdsong has been so much analyzed for its content of business communication that there seems little time left for music, but it is there. Behind the glossaries of warning calls, alarms, mating messages, pronouncements of territory, calls for recruitment, and demands for dispersal, there is redundant, elegant sound that is unaccountable as part of the working day. The thrush in my backyard sings down his nose in meditative, liquid runs of melody, over and over again, and I have the strongest impression that he does this for his own pleasure. Some of the time he seems to be practicing, like a virtuoso in his apartment. He starts a run, reaches a midpoint in the second bar where there should be a set of complex harmonics, stops, and goes back to begin over, dissatisfied. Sometimes he changes his notation so conspicuously that he seems to be improvising sets of variations. It is a meditative, questioning kind of music, and I cannot believe that he is simply saying, "thrush here."

The robin sings flexible songs, containing a variety of

motifs that he rearranges to his liking; the notes in each motif constitute the syntax, and the possibilities for variation produce a considerable repertoire. The meadow lark, with three hundred notes to work with, arranges these in phrases of three to six notes and elaborates fifty types of song. The nightingale has twenty-four basic songs, but gains wild variety by varying the internal arrangement of phrases and the length of pauses. The chaffinch listens to other chaffinches, and incorporates into his memory snatches of their songs.

The need to make music, and to listen to it, is universally expressed by human beings. I cannot imagine, even in our most primitive times, the emergence of talented painters to make cave paintings without there having been, near at hand, equally creative people making song. It is, like speech, a dominant aspect of human biology.

The individual parts played by other instrumentalists—crickets or earthworms, for instance—may not have the sound of music by themselves, but we hear them out of context. If we could listen to them all at once, fully orchestrated, in their immense ensemble, we might become aware of the counterpoint, the balance of tones and timbres and harmonics, the sonorities. The recorded songs of the humpback whale, filled with tensions and resolutions, ambiguities and allusions, incomplete, can be listened to as a *part* of music, like an isolated section of an orchestra. If we had better hearing, and could discern the descants of sea birds, the rhythmic tympani of schools of mollusks, or even the distant harmonics of midges hanging over meadows in the sun, the combined sound might lift us off our feet.

There are, of course, other ways to account for the songs of whales. They might be simple, down-to-earth statements about navigation, or sources of krill, or limits of territory. But the proof is not in, and until it is shown that these long, convoluted, insistent melodies, repeated by different singers with ornamentations of their own, are the means of

sending through several hundred miles of undersea such ordinary information as "whale here," I shall believe otherwise. Now and again, in the intervals between songs, the whales have been seen to breach, leaping clear out of the sea and landing on their backs, awash in the turbulence of their beating flippers. Perhaps they are pleased by the way the piece went, or perhaps it is celebration at hearing one's own song returning after circumnavigation; whatever, it has the look of jubilation.

I suppose that my extraterrestrial Visitor night puzzle over my records in much the same way, on first listening. The 14th Quartet might, for him, be a communication announcing, "Beethoven here," answered, after passage through an undersea of time and submerged currents of human thought, by another long signal a century later, "Bartok here."

If, as I believe, the urge to make a kind of music is as much a characteristic of biology as our other fundamental functions, there ought to be an explanation for it. Having none at hand, I am free to make one up. The rhythmic sounds might be the recapitulation of something else—an earliest memory, a score for the transformation of inanimate, random matter in chaos into the improbable, ordered dance of living forms. Morowitz has presented the case, in thermodynamic terms, for the hypothesis that a steady flow of energy from the inexhaustible source of the sun to the unfillable sink of outer space, by way of the earth, is mathematically destined to cause the organization of matter into an increasingly ordered state. The resulting balancing act involves a ceaseless clustering of bonded atoms into molecules of higher and higher complexity, and the emergence of cycles for the storage and release of energy. In a nonequilibrium steady state, which is postulated, the solar energy would not just flow to the earth and radiate away; it is thermodynamically inevitable that it must rearrange matter

into symmetry, away from probability, against entropy, lifting it, so to speak, into a constantly changing condition of rearrangement and molecular ornamentation. In such a system, the outcome is a chancy kind of order, always on the verge of descending into chaos, held taut against probability by the unremitting, constant surge of energy from the sun.

If there were to be sounds to represent this process, they would have the arrangement of the Brandenburg Concertos for my ear, but I am open to wonder whether the same events are recalled by the rhythms of insects, the long, pulsing runs of birdsong, the descants of whales, the modulated vibrations of a million locusts in migration, the tympani of gorilla breasts, termite heads, drumfish bladders. A "grand canonical ensemble" is, oddly enough, the proper term for a quantitative model system in thermodynamics, borrowed from music by way of mathematics. Borrowed back again, provided with notation, it would do for what I have in mind.