1 | DRUMS THAT TALK

(When a Code Is Not a Code)

Across the Dark Continent sound the never-silent drums: the base of all the music, the focus of every dance; the talking drums, the wireless of the unmapped jungle.

—Irma Wassall (1943)

NO ONE SPOKE SIMPLY ON THE DRUMS. Drummers would not say, "Come back home," but rather,

> Make your feet come back the way they went,
>
> make your legs come back the way they went,
>
> plant your feet and your legs below,
>
> in the village which belongs to us.

They could not just say "corpse" but would elaborate: "which lies on its back on clods of earth." Instead of "don't be afraid," they would say, "Bring your heart back down out of your mouth, your heart out of your mouth, get it back down from there." The drums generated fountains of oratory. This seemed inefficient. Was it grandiloquence or bombast? Or something else?

For a long time Europeans in sub-Saharan Africa had no idea. In fact they had no idea that the drums conveyed information at all. In their own cultures, in special cases a drum could be an instrument of signaling, along with the bugle and the bell, used to transmit a small set of messages: *attack; retreat; come to church*. But they could not conceive of talking drums. In

1730 Francis Moore sailed eastward up the Gambia River, finding it navigable for six hundred miles, all the way admiring the beauty of the country and such curious wonders as "oysters that grew upon trees" (mangroves). He was not much of a naturalist. He was reconnoitering as an agent for English slavers in kingdoms inhabited, as he saw it, by different races of people of black or tawny colors, "as Mundingoes, Jolloiffs, Pholeys, Floops, and Portuguese." When he came upon men and women carrying drums, carved wood as much as a yard long, tapered from top to bottom, he noted that women danced briskly to their music, and sometimes that the drums were "beat on the approach of an enemy," and finally, "on some very extraordinary occasions," that the drums summoned help from neighboring towns. But that was all he noticed.

A century later, Captain William Allen, on an expedition to the Niger River,[*] made a further discovery, by virtue of paying attention to his Cameroon pilot, whom he called Glasgow. They were in the cabin of the iron paddle ship when, as Allen recalled:

> Suddenly he became totally abstracted, and remained for a while in the attitude of listening. On being taxed with inattention, he said, "You no hear my son speak?" As we had heard no voice, he was asked how he knew it. He said, "Drum speak me, tell me come up deck." This seemed to be very singular.

The captain's skepticism gave way to amazement, as Glasgow convinced him that every village had this "facility of musical correspondence." Hard though it was to believe, the captain finally accepted that detailed messages of many sentences could be conveyed across miles. "We are often surprised," he wrote, "to find the sound of the trumpet so well understood in our military evolutions; but how far short that falls of the result arrived at by those untutored savages." That result was a technology much sought in Europe:

long-distance communication faster than any traveler on foot or horseback. Through the still night air over a river, the thump of the drum could carry six or seven miles. Relayed from village to village, messages could rumble a hundred miles or more in a matter of an hour.

A birth announcement in Bolenge, a village of the Belgian Congo, went like this:

> *Batoko fala fala, tokema bolo bolo, boseka woliana imaki tonkilingonda, ale nda bobila wa fole fole, asokoka l'isika koke koke.*

> The mats are rolled up, we feel strong, a woman came from the forest, she is in the open village, that is enough for this time.

A missionary, Roger T. Clarke, transcribed this call to a fisherman's funeral:

> *La nkesa laa mpombolo, tofolange benteke biesala, tolanga bonteke bolokolo bole nda elinga l'enjale baenga, basaki l'okala bopele pele. Bojende bosalaki lifeta Bolenge wa kala kala, tekendake tonkilingonda, tekendake beningo la nkaka elinga l'enjale. Tolanga bonteke bolokolo bole nda elinga l'enjale, la nkesa la mpombolo.*

> In the morning at dawn, we do not want gatherings for work, we want a meeting of play on the river. Men who live in Bolenge, do not go to the forest, do not go fishing. We want a meeting of play on the river, in the morning at dawn.

Clarke noted several facts. While only some people learned to communicate by drum, almost anyone could understand the messages in the drumbeats. Some people drummed rapidly and some slowly. Set phrases would recur again and again, virtually unchanged, yet different drummers would send

the same message with different wording. Clarke decided that the drum language was at once formulaic and fluid. "The signals represent the tones of the syllables of conventional phrases of a traditional and highly poetic character," he concluded, and this was correct, but he could not take the last step toward understanding why.

These Europeans spoke of "the native mind" and described Africans as "primitive" and "animistic" and nonetheless came to see that they had achieved an ancient dream of every human culture. Here was a messaging system that outpaced the best couriers, the fastest horses on good roads with way stations and relays. Earth-bound, foot-based messaging systems always disappointed. Their armies outran them. Julius Caesar, for example, was "very often arriving before the messengers sent to announce his coming," as Suetonius reported in the first century. The ancients were not without resources, however. The Greeks used fire beacons at the time of the Trojan War, in the twelfth century BCE, by all accounts—that is, those of Homer, Virgil, and Aeschylus. A bonfire on a mountaintop could be seen from watchtowers twenty miles distant, or in special cases even farther. In the Aeschylus version, Clytemnestra gets the news of the fall of Troy that very night, four hundred miles away in Mycenae. "Yet who so swift could speed the message here?" the skeptical Chorus asks.

She credits Hephaestus, god of fire: "Sent forth his sign; and on, and ever on, beacon to beacon sped the courier-flame." This is no small accomplishment, and the listener needs convincing, so Aeschylus has Clytemnestra continue for several minutes with every detail of the route: the blazing signal rose from Mount Ida, carried across the northern Aegean Sea to the island of Lemnos; from there to Mount Athos in Macedonia; then southward across plains and lakes to Macistus; Messapius, where the watcher "saw the far flame gleam on Euripus' tide, and from the high-piled heap of withered furze lit the new sign and bade the message on"; Cithaeron; Aegiplanetus; and her own town's mountain watch, Arachne. "So sped from stage to stage, fulfilled in turn,

flame after flame," she boasts, "along the course ordained." A German historian, Richard Hennig, traced and measured the route in 1908 and confirmed the feasibility of this chain of bonfires. The meaning of the message had, of course, to be prearranged, effectively condensed into a single bit. A binary choice, *something* or *nothing:* the fire signal meant *something*, which, just this once, meant "Troy has fallen." To transmit this one bit required immense planning, labor, watchfulness, and firewood. Many years later, lanterns in Old North Church likewise sent Paul Revere a single precious bit, which he carried onward, one binary choice: by land or by sea.

More capacity was required, for less extraordinary occasions. People tried flags, horns, intermitting smoke, and flashing mirrors. They conjured spirits and angels for purposes of communication—angels being divine messengers, by definition. The discovery of magnetism held particular promise. In a world already suffused with magic, magnets embodied occult powers. The lodestone attracts iron. This power of attraction extends invisibly through the air. Nor is it interrupted by water or even solid bodies. A lodestone held on one side of a wall can move a piece of iron on the other side. Most intriguing, the magnetic power appears able to coordinate objects vast distances apart, across the whole earth: namely, compass needles. What if one needle could control another? This idea spread—a "conceit," Thomas Browne wrote in the 1640s,

> whispered thorow the world with some attention, credulous
> and vulgar auditors readily believing it, and more judicious
> and distinctive heads, not altogether rejecting it. The conceit
> is excellent, and if the effect would follow, somewhat divine;
> whereby we might communicate like spirits, and confer on
> earth with Menippus in the Moon.

The idea of "sympathetic" needles appeared wherever there were natural philosophers and confidence artists. In Italy a man tried to sell Galileo "a

secret method of communicating with a person two or three thousand miles away, by means of a certain sympathy of magnetic needles."

> I told him that I would gladly buy, but wanted to see by experiment and that it would be enough for me if he would stand in one room and I in another. He replied that its operation could not be detected at such a short distance. I sent him on his way, with the remark that I was not in the mood at that time to go to Cairo or Moscow for the experiment, but that if he wanted to go I would stay in Venice and take care of the other end.

The idea was that if a pair of needles were magnetized together—"touched with the same Loadstone," as Browne put it—they would remain in sympathy from then on, even when separated by distance. One might call this "entanglement." A sender and a recipient would take the needles and agree on a time to communicate. They would place their needle in disks with the letters of the alphabet spaced around the rim. The sender would spell out a message by turning the needle. "For then, saith tradition," Browne explained, "at what distance of place soever, when one needle shall be removed unto any letter, the other by a wonderfull sympathy will move unto the same." Unlike most people who considered the idea of sympathetic needles, however, Browne actually tried the experiment. It did not work. When he turned one needle, the other stood still.

Browne did not go so far as to rule out the possibility that this mysterious force could someday be used for communication, but he added one more caveat. Even if magnetic communication at a distance was possible, he suggested, a problem might arise when sender and receiver tried to synchronize their actions. How would they know the time,

> it being no ordinary or Almanack business, but a probleme Mathematical, to finde out the difference of hours in different

places; nor do the wisest exactly satisfy themselves in all. For the hours of several places anticipate each other, according to their Longitudes; which are not exactly discovered of every place.

This was a prescient thought, and entirely theoretical, a product of new seventeenth-century knowledge of astronomy and geography. It was the first crack in the hitherto solid assumption of simultaneity. Anyway, as Browne noted, experts differed. Two more centuries would pass before anyone could actually travel fast enough, or communicate fast enough, to experience local time differences. For now, in fact, no one in the world could communicate as much, as fast, as far as unlettered Africans with their drums.

By the time Captain Allen discovered the talking drums in 1841, Samuel F. B. Morse was struggling with his own percussive code, the electromagnetic drumbeat designed to pulse along the telegraph wire. Inventing a code was a complex and delicate problem. He did not even think in terms of a code, at first, but "a system of signs for letters, to be indicated and marked by a quick succession of strokes or shocks of the galvanic current." The annals of invention offered scarcely any precedent. How to convert information from one form, the everyday language, into another form suitable for transmission by wire taxed his ingenuity more than any mechanical problem of the telegraph. It is fitting that history attached Morse's name to his code, more than to his device.

He had at hand a technology that seemed to allow only crude pulses, bursts of current on and off, an electrical circuit closing and opening. How could he convey language through the clicking of an electromagnet? His first idea was to send numbers, a digit at a time, with dots and pauses. The sequence ··· ·· ····· would mean 325. Every English word would be assigned a number, and the telegraphists at each end of the line would look them up in a special dictionary. Morse set about creating this dictionary himself, wasting many

hours inscribing it on large folios.* He claimed the idea in his first telegraph patent, in 1840:

> The dictionary or vocabulary consists of words alphabetically arranged and regularly numbered, beginning with the letters of the alphabet, so that each word in the language has its telegraphic number, and is designated at pleasure, through the signs of numerals.

Seeking efficiency, he weighed the costs and possibilities across several intersecting planes. There was the cost of transmission itself: the wires would be expensive and would convey only so many pulses per minute. Numbers would be relatively easy to transmit. But then there was the extra cost in time and difficulty for the telegraphists. The idea of code books—lookup tables—still had possibilities, and it echoed into the future, arising again in other technologies. Eventually it worked for Chinese telegraphy. But Morse realized that it would be hopelessly cumbersome for operators to page through a dictionary for every word.

His protégé Alfred Vail, meanwhile, was developing a simple lever key by which an operator could rapidly close and open the electric circuit. Vail and Morse turned to the idea of a coded alphabet, using signs as surrogates for the letters and thus spelling out every word. Somehow the bare signs would have to stand in for all the words of the spoken or written language. They had to map the entire language onto a single dimension of pulses. At first they conceived of a system built on two elements: the clicks (now called dots) and the spaces in between. Then, as they fiddled with the prototype keypad, they came up with a third sign: the line or dash, "when the circuit was closed a longer time than was necessary to make a dot." (The code became known as the dot-and-dash alphabet, but the unmentioned space remained just as important; Morse code was not a binary language.*) That humans could learn this new language was, at first, wondrous. They would have to master the

coding system and then perform a continuous act of double translation: language to signs; mind to fingers. One witness was amazed at how the telegraphists internalized these skills:

> The clerks who attend at the recording instrument become so expert in their curious hieroglyphics, that they do not need to look at the printed record to know what the message under reception is; the recording instrument has for them an intelligible articulate language. They understand *its speech*. They can close their eyes and listen to the strange clicking that is going on close to their ear whilst the printing is in progress, and at once say what it all means.

In the name of speed, Morse and Vail had realized that they could save strokes by reserving the shorter sequences of dots and dashes for the most common letters. But which letters would be used most often? Little was known about the alphabet's statistics. In search of data on the letters' relative frequencies, Vail was inspired to visit the local newspaper office in Morristown, New Jersey, and look over the type cases. He found a stock of twelve thousand E's, nine thousand T's, and only two hundred Z's. He and Morse rearranged the alphabet accordingly. They had originally used dash-dash-dot to represent T, the second most common letter; now they promoted T to a single dash, thus saving telegraph operators uncountable billions of key taps in the world to come. Long afterward, information theorists calculated that they had come within 15 percent of an optimal arrangement for telegraphing English text.

No such science, no such pragmatism informed the language of the drums. Yet there had been a problem to solve, just as there was in the design of a code for telegraphers: how to map an entire language onto a one-dimensional stream of the barest sounds. This design problem was solved collectively by generations of drummers in a centuries-long process of social evolution. By

the early twentieth century the analogy to the telegraph was apparent to Europeans studying Africa. "Only a few days ago I read in the *Times*," Captain Robert Sutherland Rattray reported to the Royal African Society in London, "how a resident in one part of Africa heard of the death—in another and far remote part of the continent—of a European baby, and how this news was carried by means of drums, which were used, it was stated, 'on the Morse principle'—it is always 'the Morse principle.'"

But the obvious analogy led people astray. They failed to decipher the code of the drums because, in effect, there was no code. Morse had bootstrapped his system from a middle symbolic layer, the written alphabet, intermediate between speech and his final code. His dots and dashes had no direct connection to sound; they represented letters, which formed written words, which represented the spoken words in turn. The drummers could not build on an intermediate code—they could not abstract through a layer of symbols —because the African languages, like all but a few dozen of the six thousand languages spoken in the modern world, lacked an alphabet. The drums metamorphosed speech.

It fell to John F. Carrington to explain. An English missionary, born in 1914 in Northamptonshire, Carrington left for Africa at the age of twenty-four and Africa became his lifetime home. The drums caught his attention early, as he traveled from the Baptist Missionary Society station in Yakusu, on the Upper Congo River, through the villages of the Bambole forest. One day he made an impromptu trip to the small town of Yaongama and was surprised to find a teacher, medical assistant, and church members already assembled for his arrival. They had heard the drums, they explained. Eventually he realized that the drums conveyed not just announcements and warnings but prayers, poetry, and even jokes. The drummers were not signaling but talking: they spoke a special, adapted language.

Eventually Carrington himself learned to drum. He drummed mainly in Kele, a language of the Bantu family in what is now eastern Zaire. "He is not

really a European, despite the color of his skin," a Lokele villager said of Carrington. "He used to be from our village, one of us. After he died, the spirits made a mistake and sent him off far away to a village of whites to enter into the body of a little baby who was born of a white woman instead of one of ours. But because he belongs to us, he could not forget where he came from and so he came back." The villager added generously, "If he is a bit awkward on the drums, this is because of the poor education that the whites gave him." Carrington's life in Africa spanned four decades. He became an accomplished botanist, anthropologist, and above all linguist, authoritative on the structure of African language families: thousands of dialects and several hundred distinct languages. He noticed how loquacious a good drummer had to be. He finally published his discoveries about drums in 1949, in a slim volume titled *The Talking Drums of Africa*.

In solving the enigma of the drums, Carrington found the key in a central fact about the relevant African languages. They are tonal languages, in which meaning is determined as much by rising or falling pitch contours as by distinctions between consonants or vowels. This feature is missing from most Indo-European languages, including English, which uses tone only in limited, syntactical ways: for example, to distinguish questions ("you are happy ⤵") from declarations ("you are happy ↘"). But for other languages, including, most famously, Mandarin and Cantonese, tone has primary significance in distinguishing words. So it does in most African languages. Even when Europeans learned to communicate in these languages, they generally failed to grasp the importance of tonality, because they had no experience with it. When they transliterated the words they heard into the Latin alphabet, they disregarded pitch altogether. In effect, they were color-blind.

Three different Kele words are transliterated by Europeans as *lisaka.* The words are distinguished only by their speech-tones. Thus *lisaka* with three low syllables is a puddle; *lisaka*, the last syllable rising (not necessarily stressed) is

a promise; and $_{li}{}^{saka}$ is a poison. $_{Li}{}^{a}{}_{la}$ means fiancée and $_{liala}$, rubbish pit. In transliteration they appear to be homonyms, but they are not. Carrington, after the light dawned, recalled, "I must have been guilty many a time of asking a boy to 'paddle for a book' or to 'fish that his friend is coming.' " Europeans just lacked the ear for the distinctions. Carrington saw how comical the confusion could become:

> *alambaka boili* [– _ – – _ _ _] = he watched the riverbank
>
> *alambaka boili* [– – – – _ – _] = he boiled his mother-in-law

Since the late nineteenth century, linguists have identified the phoneme as the smallest acoustic unit that makes a difference in meaning. The English word *chuck* comprises three phonemes: different meanings can be created by changing *ch* to *d*, or *u* to *e*, or *ck* to *m*. It is a useful concept but an imperfect one: linguists have found it surprisingly difficult to agree on an exact inventory of phonemes for English or any other language (most estimates for English are in the vicinity of forty-five). The problem is that a stream of speech is a continuum; a linguist may abstractly, and arbitrarily, break it into discrete units, but the meaningfulness of these units varies from speaker to speaker and depends on the context. Most speakers' instincts about phonemes are biased, too, by their knowledge of the written alphabet, which codifies language in its own sometimes arbitrary ways. In any case, tonal languages, with their extra variable, contain many more phonemes than were first apparent to inexperienced linguists.

As the spoken languages of Africa elevated tonality to a crucial role, the drum language went a difficult step further. It employed tone and only tone. It was a language of a single pair of phonemes, a language composed entirely of pitch contours. The drums varied in materials and craft. Some were slit gongs, tubes of padauk wood, hollow, cut with a long and narrow mouth to make a high-sounding lip and a low-sounding lip; others had skin tops, and these were used in pairs. All that mattered was for the drums to sound two

distinct notes, at an interval of about a major third.

So in mapping the spoken language to the drum language, information was lost. The drum talk was speech with a deficit. For every village and every tribe, the drum language began with the spoken word and shed the consonants and vowels. That was a lot to lose. The remaining information stream would be riddled with ambiguity. A double stroke on the high-tone lip of the drum [– –] matched the tonal pattern of the Kele word for father, *sango*, but naturally it could just as well be *songe*, the moon; *koko*, fowl; *fele*, a species of fish; or any other word of two high tones. Even the limited dictionary of the missionaries at Yakusu contained 130 such words. Having reduced spoken words, in all their sonic richness, to such a minimal code, how could the drums distinguish them? The answer lay partly in stress and timing, but these could not compensate for the lack of consonants and vowels. Thus, Carrington discovered, a drummer would invariably add "a little phrase" to each short word. *Songe*, the moon, is rendered as *songe li tange la manga*—"the moon looks down at the earth." *Koko*, the fowl, is rendered *koko olongo la bokiokio*—"the fowl, the little one that says kiokio." The extra drumbeats, far from being extraneous, provide context. Every ambiguous word begins in a cloud of possible alternative interpretations; then the unwanted possibilities evaporate. This takes place below the level of consciousness. Listeners are hearing only staccato drum tones, low and high, but in effect they "hear" the missing consonants and vowels, too. For that matter, they hear whole phrases, not individual words. "Among peoples who know nothing of writing or grammar, a word *per se*, cut out of its sound group, seems almost to cease to be an intelligible articulation," Captain Rattray reported.

The stereotyped long tails flap along, their redundancy overcoming ambiguity. The drum language is creative, freely generating neologisms for innovations from the north: steamboats, cigarettes, and the Christian god being three that Carrington particularly noted. But drummers begin by

learning the traditional fixed formulas. Indeed, the formulas of the African drummers sometimes preserve archaic words that have been forgotten in the everyday language. For the Yaunde, the elephant is always "the great awkward one." The resemblance to Homeric formulas—not merely Zeus, but Zeus the cloud-gatherer; not just the sea, but the wine-dark sea—is no accident. In an oral culture, inspiration has to serve clarity and memory first. The Muses are the daughters of Mnemosyne.

Neither Kele nor English yet had words to say, *allocate extra bits for disambiguation and error correction*. Yet this is what the drum language did. Redundancy—inefficient by definition—serves as the antidote to confusion. It provides second chances. Every natural language has redundancy built in; this is why people can understand text riddled with errors and why they can understand conversation in a noisy room. The natural redundancy of English motivates the famous New York City subway poster of the 1970s (and the poem by James Merrill),

> if u cn rd ths
>
> u cn gt a gd jb w hi pa!

("This counterspell may save your soul," Merrill adds.) Most of the time, redundancy in language is just part of the background. For a telegraphist it is an expensive waste. For an African drummer it is essential. Another specialized language provides a perfect analog: the language of aviation radio. Numbers and letters make up much of the information passed between pilots and air traffic controllers: altitudes, vectors, aircraft tail numbers, runway and taxiway identifiers, radio frequencies. This is critical communication over a notoriously noisy channel, so a specialized alphabet is employed to minimize ambiguity. The spoken letters *B* and *V* are easy to confuse; *bravo* and *victor* are safer. *M* and *N* become *mike* and *november*. In the case of numbers, *five* and *nine*, particularly prone to confusion, are spoken as *fife* and

niner. The extra syllables perform the same function as the extra verbosity of the talking drums.

After publishing his book, John Carrington came across a mathematical way to understand this point. A paper by a Bell Labs telephone engineer, Ralph Hartley, even had a relevant-looking formula: $H = n \log s$, where H is the amount of information, n is the number of symbols in the message, and s is the number of symbols available in the language. Hartley's younger colleague Claude Shannon later pursued this lead, and one of his touchstone projects became a precise measurement of the redundancy in English. Symbols could be words, phonemes, or dots and dashes. The degree of choice within a symbol set varied—a thousand words or forty-five phonemes or twenty-six letters or three types of interruption in an electrical circuit. The formula quantified a simple enough phenomenon (simple, anyway, once it was noticed): the fewer symbols available, the more of them must be transmitted to get across a given amount of information. For the African drummers, messages need to be about eight times as long as their spoken equivalents.

Hartley took some pains to justify his use of the word *information*. "As commonly used, information is a very elastic term," he wrote, "and it will first be necessary to set up for it a more specific meaning." He proposed to think of information "physically"—his word—rather than psychologically. He found the complications multiplying. Somewhat paradoxically, the complexity arose from the intermediate layers of symbols: letters of the alphabet, or dots and dashes, which were discrete and therefore easily countable in themselves. Harder to measure were the connections between these stand-ins and the bottom layer: the human voice itself. It was this stream of meaningful sound that still seemed, to a telephone engineer as much as an African drummer, the real stuff of communication, even if the sound, in turn, served as a code for the knowledge or meaning below. In any case Hartley thought an engineer should be able to generalize over all cases of

communication: writing and telegraph codes as well as the physical transmission of sound by means of electromagnetic waves along telephone wires or through the ether.

He knew nothing of the drums, of course. And no sooner did John Carrington come to understand them than they began to fade from the African scene. He saw Lokele youth practicing the drums less and less, schoolboys who did not even learn their own drum names. He regretted it. He had made the talking drums a part of his own life. In 1954 a visitor from the United States found him running a mission school in the Congolese outpost of Yalemba. Carrington still walked daily in the jungle, and when it was time for lunch his wife would summon him with a fast tattoo. She drummed: "White man spirit in forest come come to house of shingles high up above of white man spirit in forest. Woman with yams awaits. Come come."

Before long, there were people for whom the path of communications technology had leapt directly from the talking drum to the mobile phone, skipping over the intermediate stages.

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* The trip was sponsored by the Society for the Extinction of the Slave Trade and the Civilization of Africa for the purpose of interfering with slavers.

* "A very short experience, however, showed the superiority of the alphabetic mode," he wrote later, "and the big leaves of the numbered dictionary, which cost me a world of labor,… were discarded and the alphabetic installed in its stead."

* Operators soon distinguished spaces of different lengths—intercharacter and interword—so Morse code actually employed four signs.