FIVE

The Industrial Revolution

The Lo-Fi Soundscape of the Industrial Revolution The lo-fi soundscape was introduced by the Industrial Revolution and was extended by the Electric Revolution which followed it. The lo-fi soundscape originates with sound congestion. The Industrial Revolution introduced a multitude of new sounds with unhappy consequences for many of the natural and human sounds which they tended to obscure; and this development was extended into a second phase when the Electric Revolution added new effects of its own and introduced devices for packaging sounds and transmitting them schizophonically across time and space to live amplified or multiplied existences.

Today the world suffers from an overpopulation of sounds; there is so much acoustic information that little of it can emerge with clarity. In the ultimate lo-fi soundscape the signal-to-noise ratio is one-to-one and it is no longer possible to know what, if anything, is to be listened to. This, in summary, is the transformation of the soundscape which we will study in the next chapters.

The Industrial Revolution in England, the country which, for a variety of reasons, became the first to mechanize, took place approximately between 1760 and 1840. The principal technological changes which affected the soundscape included the use of new metals such as cast iron and steel as well as new energy sources such as coal and steam.

The textile industry was the first to undergo industrialization. John Kay's flying shuttle (1733), James Hargreaves's spinning jenny (1764–69) and Richard Arkwright's waterframe (1769) led to the development of the power loom by 1785. Increased production of finished cotton goods led to a greater demand for raw cotton, a problem which was solved in the U.S.A. by Eli Whitney's cotton gin (1793). Other industries quickly followed, for

as Alfred North Whitehead observed: "The greatest invention of the nineteenth century was the invention of the method of invention." A list of some of the more outstanding eighteenth-century inventions will allow the imaginative reader to overhear the changes in the soundscape which were worked by the new materials under the impress of new energy sources and the relentless precision of new machinery.

1711:	Sewing machine
1714:	Typewriter
1738:	Cast-iron rail tramway (at Whitehaven, England)
1740:	Cast steel
1755:	Iron wheels for coal cars
1756:	Cement manufacture
1761:	Air cylinders; piston worked by water wheel; more than tripled production of blast furnace
1765–69:	Improved steam pumping engine with separate condenser
1767:	Cast-iron rails (at Coalbrookdale)
1774:	Boring machine
1775:	Reciprocative engine with wheel
1776:	Reverberatory furnace
1781–86:	Steam engine as prime mover
1781:	Steamboat
1785:	First steam spinning mill (at Papplewick)
1785:	Power loom
1785:	Screw propeller
1787:	Iron steamship
1788:	Threshing machine
1790:	Sewing machine first patented
1791:	Gas engine
1793:	Signal telegraph
1795–1809:	Food canning
1796:	Hydraulic press
1797:	Screw-cutting lathe

The social concomitants to these changes were also profound. Agricultural workers were disfranchised and sent to the cities to seek work in the factories. Operated by steam engines, lighted by gas, the new factories could work nonstop day and night, and pauperized workers were forced to do the same. The working day was increased to sixteen hours or more, with a single hour off for dinner. Workers lived in squalid quarters near the factories, cut off from the countryside, with almost no recreational facilities except the public houses; and these, if we accept the evidence of numerous earwitnesses, became centers of much greater noise and rowdiness during the eighteenth century than before.

I have already mentioned how factories put an end to the unity of work and song. At a later date, after the reform work of men like Robert Owen, the urge for singing reappeared in the British choral societies, which flourished best in the factory towns of the North. Workmen who experienced the crucifixion of human culture then sang *Messiah* at Christmas in thousand-voice choirs.

The cacophonies of iron pushed out over the countryside first in the form of the railroad and the threshing machine. We can measure the phases of change as the new farming machinery moved out from England across Europe. While Tolstoy's Russian peasants still continued to sing over their sickles, the heroine of Hardy's *Tess of the d'Urbervilles* (contemporary of Anna Karenina) stands mutely over her work smothered by the concatenated roar of the threshing machine.

> A hasty lunch was eaten as they stood, without leaving their positions, and then another couple of hours brought them near to dinnertime; the inexorable wheels continuing to spin, and the penetrating hum of the thresher to thrill to the very marrow all who were near the revolving wirecage.

The Sounds of Technology Sweep Across Town and Country

While the philosophy of utilitarianism was sufficient to condone the inhumanities of Coketown, the machine was immediately conspicuous when it was introduced into provincial life. It took time for the sounds of technology to rub their way across Europe. The following set of earwitness accounts by writers over several generations reveals how the new sounds were gradually accepted as inevitable.

French towns were upset at first by the new rhythms and aberrational noises of the machine, as Stendhal makes clear on one of the first pages of *The Red and the Black* (1830).

> The little town of Verrières must be one of the prettiest in the Franche-Comté. Its white houses with their steep, red tile roofs spread across a hillside, the folds of which are outlined by clumps of thrifty chestnut trees. The Doubs flows a couple of hundred feet below the town's fortifications, built long ago by the Spaniards and now fallen into ruins. . . .
>
> Scarcely inside the town, one is stunned by the racket of a roaring machine, frightful in its appearance. Twenty ponderous hammers, falling with a crash which makes the street shudder, are lifted for each new stroke by the power of a water wheel. Every one of these hammers makes, every day, I don't know how many thousand nails. Young, pretty, fresh-faced girls, slip little slivers of iron into place beneath the sledge hammers, which promptly transform them into nails.

By 1864 French towns were alive with factories, and were described with disdain by the Goncourts.

> A vague, indeterminate smell of grease and sugar, mixed with the emanations from the water and the smell of tar, rose from the candle factories, the glue factories, the tanneries, the sugar refineries, which were scattered about on the quay amongst thin, dried-up grass. The noise of foundries and the screams of steamwhistles broke, at every moment, the silence of the river.

By the early twentieth century the sounds of technology became more acceptable to the urban ear, "blending" with the natural rhythms of antiquity. As Thomas Mann described it:

> We are encompassed with a roaring like that of the sea; for we live almost directly on the swift-flowing river that foams over shallow ledges at no great distance from the poplar avenue.... There is a locomotive foundry a little way downstream. Its premises have been lately enlarged to meet increased demands, and light streams all night long from its lofty windows. Beautiful glittering new engines roll to and fro on trial runs; a steam whistle emits wailing head-tones from time to time; muffled thunderings of unspecified origin shatter the air.... Thus in our half-suburban, half-rural seclusion the voice of nature mingles with that of man, and over all lies the bright-eyed freshness of the new day.

Ultimately the throb of the machine began to intoxicate man everywhere with its incessant vibrations. D. H. Lawrence (1915): "As they worked in the fields, from beyond the now familiar embankment came the rhythmic run of the winding engines, startling at first, but afterwards a narcotic to the brain."

Eventually then the noises of modern industrial life swung the balance against those of nature, a fact which the futurist, Luigi Russolo, was the first to point out in his manifesto *The Art of Noises* (1913). Writing on the eve of the First World War, Russolo excitedly proclaimed that the new sensibility of man depended on his appetite for noises, which would achieve their grandest opportunity for expression in mechanized warfare.

Noise Equals Power We have gone far enough to show how the soundscape of both city and country was being transmogrified during the eighteenth and nineteenth centuries. We are now confronted by an enigma: despite the vast increase in noise that the new machines created, rarely do we find opposition to these noises.

In England, the first criticism of working conditions in factories was that of Sadler's Factory Investigating Committee of 1832. This pathetic seven-hundred-page document is filled with hideous descriptions of bru-

tality and human degradation—shifts extending to thirty-five hours, children sleeping in the mills in order not to be late for work, workers collapsing into the machines from sheer fatigue, alcoholism among children—but nowhere is noise mentioned as a factor contributing to the tragedy of these environments. Only once or twice does one encounter there a reference to the "rumbling noise" of the machinery. When sound is noticed it is usually the screams of the workers when they are beaten.

> I happened to be at the other end of the room, talking; and I heard the blows, and I looked that way, and saw the spinner beating one of the girls severely with a large stick. Hearing the sound led me to look round, and to ask what was the matter, and they said it was "Nothing but —— paying [beating] his ligger-on."

The only time the machines were ever stopped was to impress visitors, or during meal breaks, when the children had to clean them on their own time. Otherwise they rattled on undetected, and Sadler's interviewees even spoke of the "silence" of the mills, by which they meant the "rule of silence." "Is one part of the discipline of these mills profound silence?—Yes, they will not allow them to speak; if they chance to see two speaking, they are beaten with the strap."

The only people to criticize the "prodigious noise" of machinery were the writers, figures like Dickens and Zola. Dickens, in *Hard Times* (1854):

> Stephen bent over his loom, quiet, watchful, and steady. A special contrast, as every man was in the forest of looms where Stephen worked, to the crashing, smashing, tearing piece of mechanism at which he laboured.

Zola, in *Germinal* (1885):

> And now it had occurred to him to open the steam-cocks and let out the steam. The jets went off like gunshots and the five boilers blew off like hurricanes, with such a thunderous hissing that your ears seemed to be bleeding.

Despite these attacks, it was still to be a hundred years before noise criteria would be established and enforced as part of hygiene programs in industry. Neither unions nor social reformers nor the medical profession caught the theme. Noise was certainly known to cause deafness as early as 1831 when Fosbroke described deafness occurring among blacksmiths, but this remained an isolated study until 1890 when Barr surveyed one hundred boilermakers and discovered that not one of them had normal hearing.* Hammering and riveting steel plates together produced an intense noise, resulting in a form of hearing impairment in which there is

*The earliest study of industrial deafness that I have been able to discover was that of Bernardino Ramazzini, *Diseases of Workers* (*De Morbis Artificium*), 1713.

deafness to high frequencies. The term "boilermaker's disease" came into use shortly afterward to refer to all kinds of industrial hearing loss, though its prevention only received serious consideration in most industrialized countries toward 1970.

The inability to recognize noise during the early phases of the Industrial Revolution as a factor contributing to the multiplicatory toxicity of the new working environments is one of the strangest facts in the history of aural perception. We must try to determine the reason. It may be partly explained as a result of the inability to measure sounds quantitatively. A sound might be recognized as unpleasantly loud, but until Lord Rayleigh built the first practical precision instrument for the measurement of acoustic intensity in 1882, there was no way of knowing for certain whether a subjective impression had an objective basis. The decibel, as a means of establishing definite sound pressure levels, did not come into extended use until 1928.

But I want to extend a thought which I had begun to develop in Part One. We have already noted how loud noises evoked fear and respect back to earliest times, and how they seemed to be the expression of divine power. We have also observed how this power was transferred from natural sounds (thunder, volcano, storm) to those of the church bell and pipe organ. I called this Sacred Noise to distinguish it from the other sort of noise (with a small letter), implying nuisance and requiring noise abatement legislation. This was always primarily the rowdy human voice. During the Industrial Revolution, Sacred Noise sprang across to the profane world. Now the industrialists held power and they were granted dispensation to make Noise by means of the steam engine and the blast furnace, just as previously the monks had been free to make Noise on the church bell or J. S. Bach to open out his preludes on the full organ.

The association of Noise and power has never really been broken in the human imagination. It descends from God, to the priest, to the industrialist, and more recently to the broadcaster and the aviator. The important thing to realize is this: to have the Sacred Noise is not merely to make the biggest noise; rather it is a matter of having the authority to make it without censure.

Wherever Noise is granted immunity from human intervention, there will be found a seat of power. The noisy clank of Watt's original engine was maintained as a sign of power and efficiency, against his own desire to eliminate it, thus enabling the railroads to establish themselves more emphatically as the "conquerers" that I will, in a moment, let Charles Dickens describe. A glance at the sound output of any representative selection of modern machines is enough to indicate where the centers of power lie in the modern world.

Steam engine	85 dBA
Printing works	87 dBA
Diesel-electric generator house	96 dBA

Screw-heading machine	101 dBA
Weaving shed	104 dBA
Sawmill chipper	105 dBA
Metalwork grinder	106 dBA
Wood-planing machine	108 dBA
Metal saw	110 dBA
Rock band	115 dBA
Boiler works, hammering	118 dBA
Jet taking off	120 dBA
Rocket launching	160 dBA

Sound Imperialism The historian Oswald Spengler distinguishes two phases in the development of a social movement: the cultural phase, during which the main ideas are still maturing; and the civilization phase, during which the main ideas, having matured, are legalized and transmitted abroad. Imperialism is the word used to refer to the extension of an empire or ideology to parts of the world remote from the source. It is Europe and North America which have, in recent centuries, masterminded various schemes designed to dominate other peoples and value systems, and subjugation by Noise has played no small part in these schemes. Expansion took place first on land and sea (train, tank, battleship) and then in the air (planes, rocketry, radio). The moon probes are the most recent expression of the same heroic confidence that made Western Man a world colonial power.

When sound power is sufficient to create a large acoustic profile, we may speak of it, too, as imperialistic. For instance, a man with a loudspeaker is more imperialistic than one without because he can dominate more acoustic space. A man with a shovel is not imperialistic, but a man with a jackhammer is because he has the power to interrupt and dominate other acoustic activities in the vicinity. (In this sense we note that outside workers were able to improve their position remarkably after they were in possession of tools to attract attention to themselves. No one listens to a ditchdigger.) Similarly, the growing importance of the international aviation industry can be easily assessed from the growth patterns of airport noise profiles. Western Man leaves his calling cards all over the world in the form of Western-made or Western-inspired machinery. As the factories and the airports of the world multiply, local culture is pulverized into the background. Everywhere one travels today one hears the evidence, though only in the more remote places is the incongruity immediately striking.

Increase in the intensity of sound output is the most striking characteristic of the industrialized soundscape. Industry must grow; therefore its sounds must grow with it. That is the fixed theme of the past two hundred years. In fact, noise is so important as an attention-getter that if quiet machinery could have been developed, the success of industrialization

might not have been so total. For emphasis let us put this more dramatically: if cannons had been silent, they would never have been used in warfare.

The Flat Line in Sound The Industrial Revolution introduced another effect into the soundscape: the flat line. When sounds are projected visually on a graphic level recorder, they may be analyzed in terms of what is called their envelope or signature. The principal characteristics of a sound envelope are the attack, the body, the transients (or internal changes) and the decay. When the body of the sound is prolonged and unchanging, it is reproduced by the graphic level recorder as an extended horizontal line.

Machines share this important feature, for they create low-information, high-redundancy sounds. They may be continuous drones (as in a generator); they may be rough-edged, possessing what Pierre Schaeffer calls a "grain" (as in mechanical sawing or filing); or they may be punctuated with rhythmic concatenations (as in weaving or threshing machines) —but in all cases it is the continuousness of the sound which is its predominating feature.

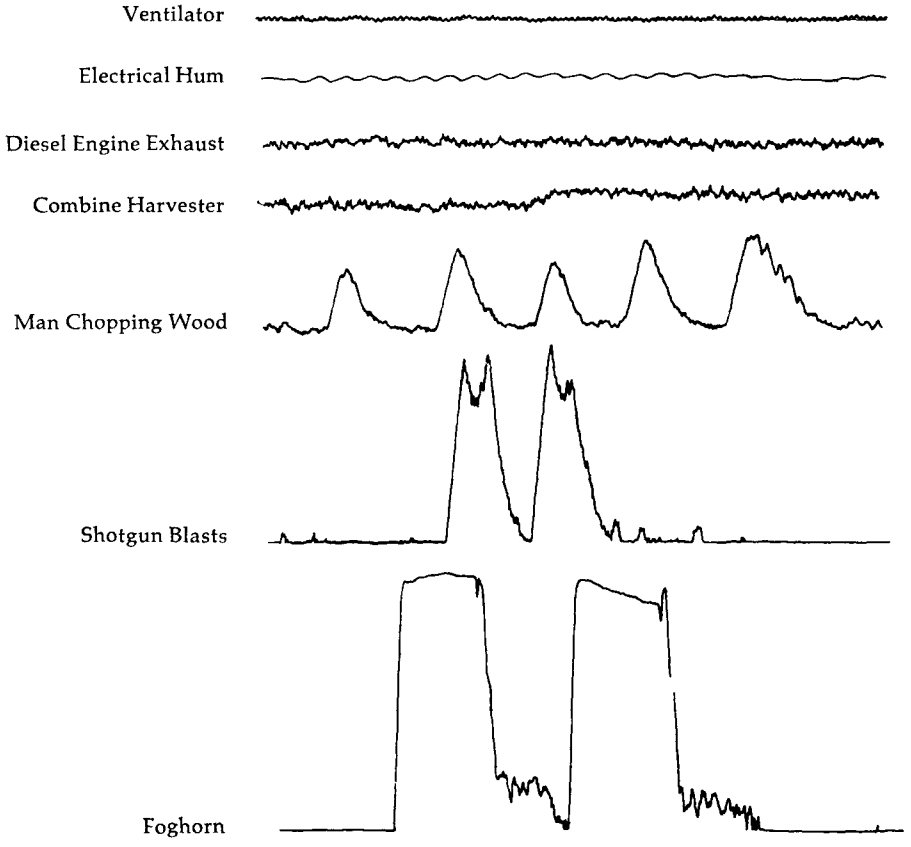
The flat continuous line in sound is an artificial construction. Like the flat line in space, it is rarely found in nature. (The continuous stridulation of certain insects like cicadas is an exception.) Just as the Industrial Revolution's sewing machine gave us back the long line in clothes, so the factories, which operated night and day nonstop, created the long line in sound. As roads and railroads and flat-surfaced buildings proliferated in space, so did their acoustic counterparts in time; and eventually flat lines in sound slipped out across the countryside also, as the whine of the transport truck and the airplane drone demonstrate.

A few years ago, while listening to the stonemasons' hammers on the Takht-e-Jamshid in Teheran, I suddenly realized that in all earlier societies the majority of sounds were discrete and interrupted, while today a large portion—perhaps the majority—are continuous. This new sound phenomenon, introduced by the Industrial Revolution and greatly extended by the Electric Revolution, today subjects us to permanent keynotes and swaths of broad-band noise, possessing little personality or sense of progression.

Just as there is no perspective in the lo-fi soundscape (everything is present at once), similarly there is no sense of duration with the flat line in sound. It is suprabiological. We may speak of natural sounds as having biological existences. They are born, they flourish and they die. But the generator or the air-conditioner do not die; they receive transplants and live forever.

The flat line in sound emerges as a result of an increased desire for speed. Rhythmic impulse plus speed equals pitch. Whenever impulses are speeded up beyond 20 occurrences or cycles per second, they are fused together and are perceived as a continuous contour. Increased efficiency in manufacturing, transportation and communication systems fused the im-

pulses of older sounds into new sound energies of flat-line pitched noise. Man's foot sped up to produce the automobile drone; horses' hooves sped up to produce the railway and aircraft whine; the quill pen sped up to produce the radio carrier wave, and the abacus sped up to produce the whirr of computer peripherals.



Graphic level recordings of typical flat-line and impact sounds.

Henri Bergson once asked how we should know about it if some agent suddenly doubled the speed of *all* events in the universe? Quite simply, he replied, we should discern a great loss in the richness of experience. Even as Bergson wrote, this was happening, for as discrete sounds gave way to flat lines, the noise of the machine became "a narcotic to the brain," and listlessness increased in modern life.

The function of the drone has long been known in music. It is an anti-intellectual narcotic. It is also a point of focus for meditation, particularly in the East. Man listens differently in the presence of drones, and the importance of this change in perception is becoming evident in the West.

The flat line in sound produces only one embellishment: the glissando —that is, as the revolutions increase the pitch gradually rises, and as they decrease the pitch descends. Then flat lines become curved lines. But they are still without sudden surprises. When flat lines become jerky or dotted or looping lines—the machinery is falling apart.

Another type of curve produced by the flat line is the Doppler effect, which results when a sound is in motion at sufficient velocity to cause a bunching up of the sound waves as the sound approaches an observer (resulting in a rise in pitch) and an elongation of the sound waves as the sound recedes (resulting in a lowering of pitch). There are certainly Doppler effects in nature (the flight of a bee, for instance, or the galloping of horses) but only after the new speeds of the Industrial Revolution did the effect become conspicuous enough to be "discovered." Christian Johann Doppler (1803–53) formulated the explanation of the effect to which he has bequeathed his name in a work entitled *Über das Farbige Licht der Doppelsterne,* where he applied the principle to light waves. But Doppler acknowledged that he worked by analogy from sound to light.

Some sounds move in space, some do not; and we may move some sounds by carrying them with us. But which sound attracted Doppler's ear? It could only have been the railway. Although he does not mention this, we do know trains were used to verify the Doppler effect. About 1845 "musically trained observers were stationed along the tracks of the Rhine Railroad between Utrecht and Maarsen in Holland and listened to trumpets played in a railway car as it sped past. From the known pitch of the trumpet and the apparent pitch of the approaching and receding tones, the speed of the railway car was estimated with fairly good accuracy."

The Lore of Trains The first railway was the Stockton and Darlington run in England (1825), designed to carry coal from the mines to the waterways. It proved so immediately successful that within a few years Britain was covered with a railway network. Dickens described the new sound in 1848:

> Night and day the conquering engines rumbled at their distant work, or, advancing smoothly to their journey's end, and gliding like tame dragons into the allotted corners grooved out to the inch for their reception, stood bubbling and trembling there, making the walls quake, as if they were dilating with the secret knowledge of great powers yet unsuspected in them, and strong purposes not yet achieved.

From England the railway system fanned out quickly across Europe and the world. France had a railway by 1828 as did the U.S.A., Ireland by 1834, Germany by 1835, Canada by 1836, Russia by 1837, Italy by 1839, Spain by 1848, Norway and Australia by 1854, Sweden by 1856 and Japan by 1872.

The train conquered the world with a minimum of opposition. Dickens didn't like it: "Louder and louder yet, it shrieks and cries as it comes tearing on resistless to the goal." Neither did Wagner, and although the Bavarian College of Medicine protested in 1838 that the speed with which trains traveled would undoubtedly cause brain damage, the trains remained and the tracks multiplied.

Of all the sounds of the Industrial Revolution, those of trains seem across time to have taken on the most attractive sentimental associations. J. M. W. Turner's celebrated painting *Rain, Steam and Speed* (1844), with its locomotive thrusting down diagonally on the spectator, was the first lyric inspired by the steam engine. It was a painter, too, who caught the next change in the epic of the railroads. By 1920 the main lines of Europe (though not of England and North America) were being electrified, and the change is recorded in de Chirico's wistful landscapes, where silent smoke-puffing trains pass out of sight in the extreme distance.

By comparison with the sounds of modern transportation, those of the trains were rich and characteristic: the whistle, the bell, the slow chuffing of the engine at the start, accelerating suddenly as the wheels slipped, then slowing again, the sudden explosions of escaping steam, the squeaking of the wheels, the rattling of the coaches, the clatter of the tracks, the thwack against the window as another train passed in the opposite direction—these were all memorable noises.

The sounds of travel have deep mysteries. Just as the post horn had once carried the imagination over the horizon, so also did its replacement, the train whistle. On European trains the whistle is high and piping: "Then the shrill whistle of the trains reechoed through the heart, with fearsome pleasure, announcing the far-off come near and imminent."

In North America, on the other hand, the whistle is low and powerful, the utterance of a big engine with a heavy load. On the prairies—so flat that one can see the full train from engine to caboose, spread out like a stick across the horizon—the periodic whistlings resound like low, haunting moans. "The Canadian train whistle sounds like a dejected monster. It wails, and the pitch descends, unlike that of our British trains which rises in a chirpy and optimistic manner. The Canadian whistle sounds as if it has travelled far and still has a long way to go." Farmers knew how to interpret these sounds. "When the train's whistle sounds hollow, the weather will turn colder," runs an Ontario proverb. The train's whistle was the most important sound in the frontier town, the solo announcement of contact with the outside world. It was the stop clock of the elementary community, as predictable and reassuring as the church bell. In those days trains spoke to the heart of every man, and small boys came to greet the panting engine.

Trains speak to each other too. Each railroad employs a binary code of whistle signals by which quite precise messages can be communicated. But unlike the signals of the post horn, which we are given to understand everyone knew, the language of the trains is a mystery code, known to the

trainmen alone. Even without knowing the codes, those who listen attentively to the soundscape will notice the personality and style each engineer manages to bring to these elementary utterances. Some slur the signals, barely distinguishing the articulations; others separate each blast with lengthy pauses. With considerable artistry others manage to get the notes to slide in pitch by careful manipulation of the control valve. This last style of performance is atavistic, carrying us back to the old steam whistle which was naturally tapered at the edges. The original steam whistle was three-toned. Part of the fame of the legendary American engineer Casey Jones was acoustic, for Casey had a special five-tone whistle which he carried with him wherever he went.

Besides the variations in rhythm and articulation, the listener will also notice differences in sound quality and pitch. While the old steam whistles produced a cluster of frequencies, many modern whistles, especially on diesel engines, are single tones. Others are diads or triads, tuned in the factory, sometimes to the specifications of the customer. While American railroads have preferred the single pitch, Canadian railroads have withdrawn this type of whistle due to the number of level-crossing accidents attributed to it during the changeover period from steam to diesel engines. An attempt to reproduce the quality of the original steam whistle resulted in the adoption of specifically tuned air horns, one version of which, now used by the Canadian Pacific Railroad, is the E-flat minor triad in root position with the tonic pitched at 311 hertz. This deep and haunting whistle, sounded by every train, who knows how many thousands of times during the long haul from Atlantic to Pacific through spectacular and lonely countryside, provides the unifying soundmark of the nation. More than any other sound it is uncounterfeitingly Canadian.

> The improvement in city conditions by the general adoption of the motorcar can hardly be overestimated. Streets—clean, dustless and odorless—with light rubber-tired vehicles moving swiftly and *noiselessly* over their smooth expanse would eliminate a greater part of the nervousness, distraction and strain of modern life.
>
> *Scientific American,* July, 1899

The Internal Combustion Engine The internal combustion engine now provides the fundamental sound of contemporary civilization. It is the keynote, as surely as water was the keynote of thalassocratic civilization, and the wind is the keynote of the steppes.

In the external combustion engine a load of water is mixed with a load of coal to produce driving energy. Coal and water are bulky and heavy. The steam locomotive was accordingly confined to public enterprises. The internal combustion engine is light and easy to operate; it transferred power to the individual. In industrially advanced societies the average citizen may operate several internal combustion engines in the course of an average day

(car, motorcycle, truck, power lawnmower, tractor, generator, power tools, etc.) and the sound will be heard in his ear many hours each day.

By 1970, the United States was producing more automobiles annually than babies, but the Asian market still looked encouraging. An advertisement in *The New Yorker* magazine that year showed the globe with every available land mass covered with Hertz rent-a-cars. By that date classic cities of gems and germs like Istanbul and Isfahan had also become cities of incredible traffic jams. The reason for this was not merely the volume of traffic, but the way in which vehicles were driven. In order for a society to obey traffic codes it must have survived two important experiences: the Industrial Revolution and mechanized warfare. Americans can drive on the "belt" road (note the name) around Washington with great adroitness, but the Asian still drives his car as if it were a camel or a mule. Stoplights are ignored and the horn becomes a whip with which to cajole and punish the stubborn animal.

When two swaths of broad-band noise of the same intensity are superposed the result is an increase of approximately three decibels. Two cars, each producing a sound of 80 decibels, thus give a sound of 83 decibels. Assuming constant engine noise, each doubling of production in the automobile industry would give an elevation of three decibels of broad-band noise to the sonic environment. In fact, automobile engines are not uniformly constructed. The American manufacturers, for instance, produced their quietest automobiles around 1960. During the sixties they began to get louder again. By 1971 the Detroit manufacturers had begun to make the increased noise of their machines an advertised feature. The following is a magazine advertisement:

THE
1971
MUSCLE
CARS

This sleek, high-powered monster is
American Motors' 7 Javelin AMX.
Press the accelerator,
it roars.

That year General Motors informed us that

> . . . the trend toward large displacement engines and higher compression ratios makes for increased engine noise, induction, and exhaust noise . . . higher compression ratios . . . result in larger deformations of the engine-block structure and, hence, higher radiated noise levels. . . . We feel, on the basis of many cars, that muffler design and performance have nicely kept pace with requirements.

Today the value of the automobile is under serious scrutiny. As local noise abatement by-laws and practices seek to reduce its sound output by

setting increasingly tough noise standards, in the end perhaps only energy shortages will silence it. As the automobile becomes obsolete, its rattle becomes deathening.

Sheer volume aside, the human sound which most closely approximates that of the internal combustion engine is the fart. The analogies between the automobile and the anus are conspicuous. First of all the exhaust pipe is placed at the rear, at the same position as the rectum in animals. Cars are also stored in dirty and dark underground garages, beneath the haunches of the modern dwelling. Freud says there are anal types. There are probably also anal eras.

The Growth of Muscle Sounds Someone once observed—I think it was Aldous Huxley—that for contemporary urban man half the imagery of traditional poetry was lost. The same thing is happening to the soundscape, where the sounds of nature are being lost under the combined jamming of industrial and domestic machinery. More is less. A couple of illustrations from close to home will suffice to illustrate the equation.

In 1959 Canada manufactured $8,596,000 worth of power chainsaws; by 1969 this had risen to $26,860,000. The power chainsaw produces a sound of between 100 and 120 dBA, giving it a sweepout in a quiet forest of 8 to 10 square kilometers. It is possible to theorize that by 1974 the combined ripping of the 316,781 power chainsaws produced that year alone, if operated simultaneously, could cover about one-third of Canada's 9,222,977 square kilometers with their sound.

A West Coast Indian girl taught me how to listen to the voices of the trees through the bark of their trunks. "They tell the story of my people," she said. When the white men arrived in British Columbia, they could not teach the Indians to use the mechanical saw, or to fell trees in such a way that one tree could be made to knock down four others—the so-called domino technique. When the spirit of the deity inhabits the tree, one hesitates. Today, as the jabberware of the forest industry bevels down the woods, no one hears the frightened cries of the tree victims.

"If a tree might move by foot or wing it would not suffer the pain of the saw or the blows of the axe," wrote Rumi in the thirteenth century. As a matter of fact, we do know that trees and other vegetables tremble and send out electrical emergency charges before they are cut.

The snowmobile will serve as our other example of the devastating effect the careless introduction of technology can have on a society. The snowmobile, a Canadian discovery, is a recent invention but its ramming has already transmogrified the Canadian winter. Only in 1970, after millions of Canadians were being exposed to this new form of noise, was the National Research Council able to conduct research demonstrating that existing machines "present a definite hazard to hearing." Their report showed that machines then on the market frequently exceeded 110 dBA

at the drivers' ear. The NRC recommended reducing the noise to 85 dBA (thereby at least lessening the risk of hearing damage) and they showed how this could be done. But the federal government responded by limiting the noise level of new machines to 82 dBA at 50 feet (i.e., approximately 92 dBA at 15 feet).

The intrusion of snowmobiles has now made deafness and ear disease the largest public health problem in the Canadian Arctic, according to Dr. J. D. Baxter, head of McGill University's Otolaryngological Department. In his 1972 address to the Canadian Otolaryngological Society he pointed out that of 156 adult Eskimos examined in one area, 97 showed a significant hearing loss. The Canadian winter used to be noted for its purity and serenity. It was part of the Canadian mythology. The snowmobile has bitched the myth. Without a myth the nation dies.

> . . . no sound issues from a cloudless quarter of the sky.
>
> Lucretius, *On the Nature of Things,* VI, 96

The Big Sound Sewer of the Sky It would be false to assume that man only became airborne in the twentieth century. In fact, man has always been airborne in his imagination, as the numerous magic carpets of folklore prove. The twentieth century has merely reduced the limitless spaces where the imagination soared to rare altitudes to specific air corridors of no intrinsic significance whatsoever. Listen to the sky. The whirring and scraping against the air is nothing but the wounds of a crippled imagination made audible. At one time it was only those unfortunate enough to live near airports who really suffered from aircraft noise. In those days a passing plane turned all heads upward. But since the Second World War all this has changed.

Sometimes I give a class of students the assignment: "You are facing south. You are to wait until a sound passes you by traveling from northeast to southwest." It may take two minutes. It may take two hours. Usually it takes two minutes. Usually it is a plane. "Air travel is doubling every five years, and air freight is growing still faster. . . . Thus . . . the noise goes up in the ratio of the horsepower used in the industry as a whole, that is, it doubles every five years in aviation."

This forecast refers only to the spread of noise energy in the sky. It assumes that we will continue to employ present-day aircraft but simply in greater numbers. To this we must add the very special problems of supersonic transport or any other aberrations that the international aviation industry may still be perpetrating on the drawing boards.

As every home and office is gradually being situated along the world runway, the aviation industry, perhaps more effectively than any other, is

destroying the words "peace and quiet" in every world language. For noise in the sky is distinguished radically from all other forms of noise in that it is not localized or contained. The plangent voice of the airplane motor beams down directly on the whole community, on roof, garden and window, on farm and suburb as well as city center.

In our research on the Vancouver soundscape we showed that the annual traffic of aircraft over a downtown park in 1970 was 23,000 per year and that this had grown by 1973 to 38,700—a trend well in line with the quotation above. We also showed that in 1973 the same park soundscape was filled with aircraft noise, from the time each flight was detected on the acoustic horizon until it disappeared, for an average of 27 minutes per hour; and from our research we are able to predict that if the trend continues the noise will be total and uninterrupted by 1981.

A great deal of research has taken place on aircraft noise and it is going forward today more strenuously than ever; but the problem continues to grow. While most of the research has concentrated on the superscreams of jets (and it has succeeded in making the jumbo jets slightly quieter than their predecessors), the insidious jamming of smaller aircraft—for instance, the bitter-batter of helicopters—has been given practically no attention.

The advent of supersonic transports has succeeded in focusing additional public attention on the problem of aircraft noise. Not only do such aircraft produce more noise on take-off and landing, resulting in "a growth in far afield noise accompanied by a serious worsening of the lateral noise spread in the vicinity of the airport," but the most critical feature of this aircraft is that by flying faster than the speed of sound it produces an additional thunderclap called a sonic boom. Unlike the sound of other aircraft, the bang-zone of the supersonic transport boom is about fifty miles wide and extends along the entire length of the aircraft flight path. Supersonic aircraft turn the whole world into an airport.

Let's use the German word *Überschallknall* instead of sonic boom; its ugly syllabification seems more suitable. In addition to its startling noise, the heavier vibrations of the *Überschallknall* can cause serious property damage, smash windows, crack walls and ceilings. On the basis of trial runs of supersonic aircraft in the U.S.A. (the small fighter variety only) and the resulting damage suits filed, it has been estimated that each supersonic flight across that country would startle up to forty million people. In Chicago, test flights over the city resulted in 6,116 complaints and 2,964 damage claims.

As a result of these forecasts, and because in order for supersonic aircraft to be economically viable they must be flown at supersonic speeds as frequently as possible, the Americans in 1972 abandoned their plans to develop such aircraft for commercial purposes. Many countries of the world have banned the flight of supersonic aircraft over their territories, and while the British and French as well as the Russians have such planes, they are now beginning to look like the biggest white elephants of all time.

The supersonic aircraft was an attempt to outmaneuver sound. It failed.

The Deaf Ear of the Aviator Rather than assist in finding solutions to the problems of aircraft noise, the commercial airlines have turned a deaf ear. They have preferred instead to spend enormous sums of money to pretend that the problem does not exist. If planes make any sound at all, the advertising implies, they are happy sounds. Witness:

- Eastern Airlines "Whisper Jet Service"
- "Fly the Friendly Skies of United."
- "Trident-Two is fast, smooth, quiet and reliable." (BEA)
- "Fly across the Atlantic on the Quiet." (BOAC)
- "We have smart new DC-9 jets with engines quietly at the rear." (Air Jamaica)
- "The DC-10 is a quiet plane that whispers its way through airports." (KLM)
- "More and more people-pleasing 747s are bringing more and more big-jet comfort to more and more cities and towns." (Boeing)

Big jets as people pleasers? Question: What obligation does an airline have to people outside or beneath its aircraft?

On the Acropolis in Athens there is a sign reading:

THIS IS A SACRED PLACE.
IT IS FORBIDDEN TO SING OR
MAKE LOUD NOISES OF ANY KIND.

When I was last there in 1969 the Acropolis was grazed by seventeen jets. Against this hypocrisy we offer the news that Christ and Buddha were also aviators, and wonder what kind of noise they made as they mounted up into the air.

Counter-Revolution Opposing the developments described in this chapter, there has been, over the past decade, a counter-revolution in many countries around the world. Technological noise is the target for increasing opposition and in a rapidly growing number of instances it is being met directly by noise abatement legislation. As the dangers of excessive noise have been known for at least one hundred fifty years, this sudden expression of interest in the subject, while welcome, raises the question: *Why only now?* Perhaps it is part of a general criticism of the direction in which reckless technology has been taking us. If this is so, the industrialist as God has fallen, and his divine license to make the Sacred Noises without prosecution has ended. I think, and I am merely testing an idea in this sentence, that what we are witnessing in the recent noise abatement campaigns is not so much an attempt to silence the world as an attempt to wrest Sacred Noise from industry as a prelude to the discovery of a more trustworthy proprietor to whom the power may be bequeathed.