SATURN and NOISE

GEORGE C. MARSHALL SPACE FLIGHT CENTER
HTTP://HEROICRELICS.ORG
HUNTSVILLE, ALABAMA

Meet D. B. Noyes. This little fellow is going to help us at the George C. Marshall Space Flight Center explain to you the nature and effects of the noise which Saturn makes during static firing tests.

SATURN AND NOISE

contents

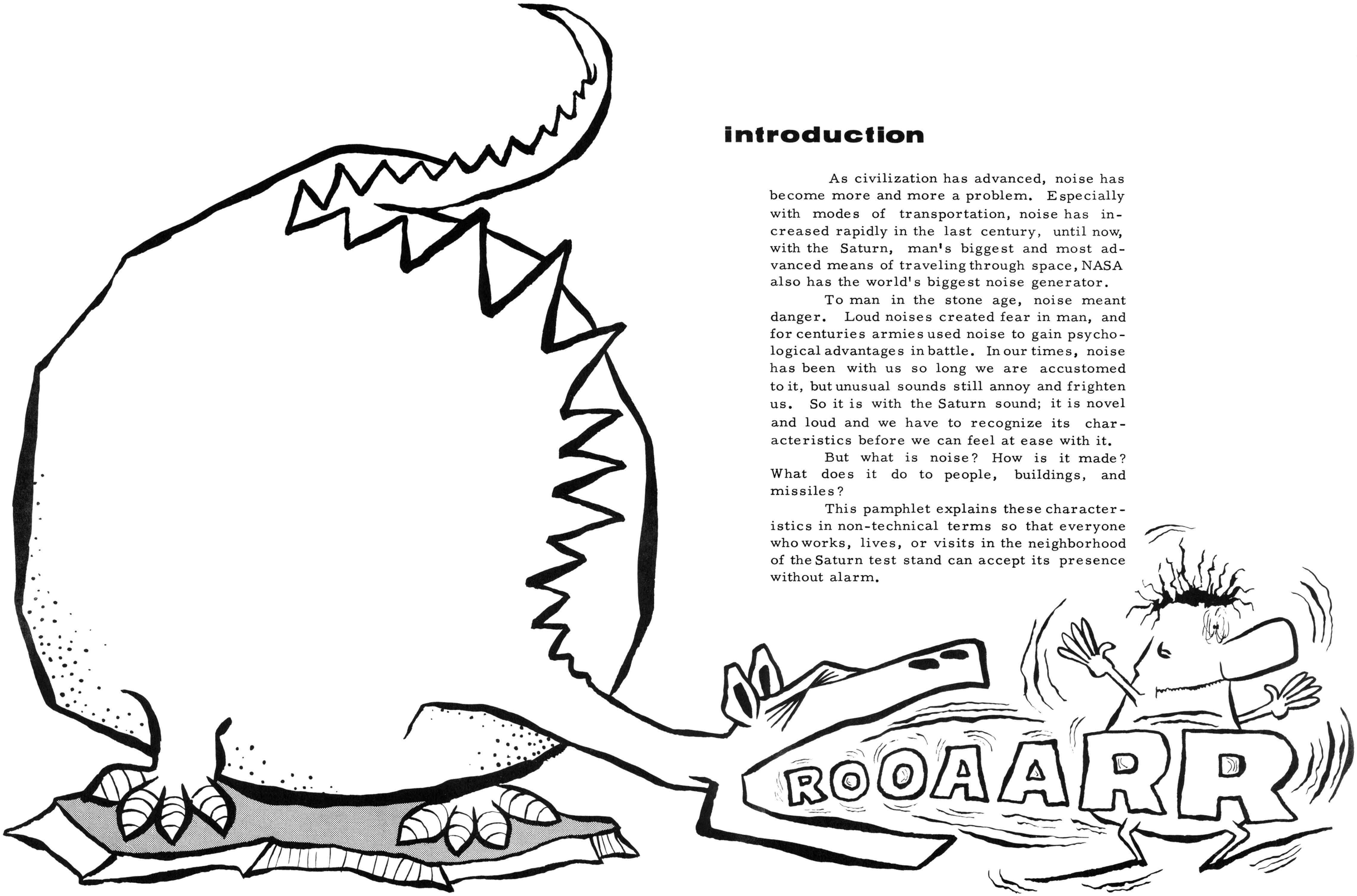
introduction

As civilization has advanced, noise has become more and more a problem. Especially with modes of transportation, noise has increased rapidly in the last century, until now, with the Saturn, man's biggest and most advanced means of traveling through space, NASA also has the world's biggest noise generator.

To man in the stone age, noise meant danger. Loud noises created fear in man, and for centuries armies used noise to gain psychological advantages in battle. In our times, noise has been with us so long we are accustomed to it, but unusual sounds still annoy and frighten us. So it is with the Saturn sound; it is novel and loud and we have to recognize its characteristics before we can feel at ease with it.

But what is noise? How is it made? What does it do to people, buildings, and missiles?

This pamphlet explains these characteristics in non-technical terms so that everyone who works, lives, or visits in the neighborhood of the Saturn test stand can accept its presence without alarm.



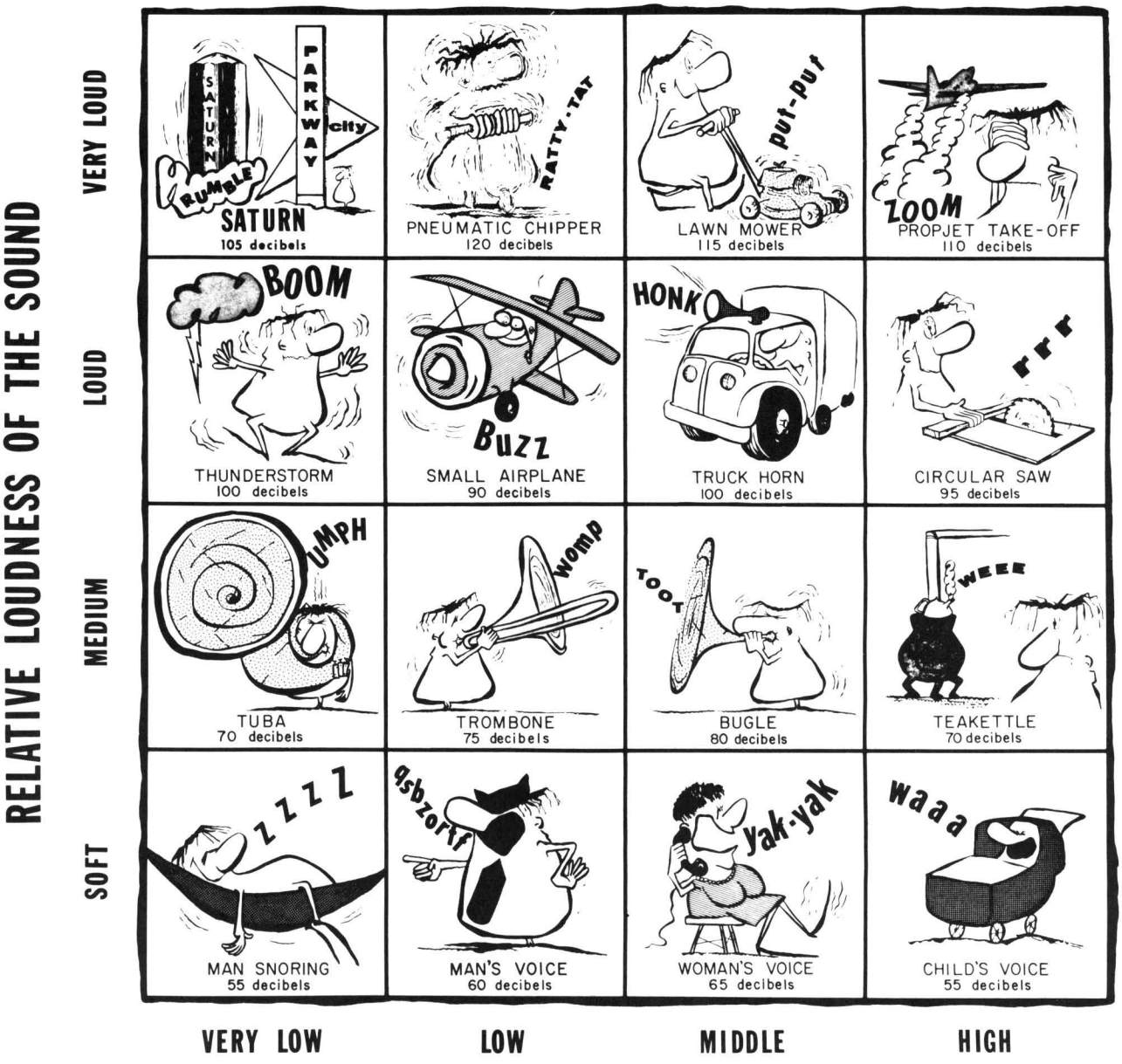
sound and noise

Many sources of sound are created by vibrating bodies causing disturbances in the air. Other sources, such as the Saturn Booster, generate sound by the velocity of exhaust gases causing disturbances in the air. These disturbances set up vibrations in the air, and only when these vibrations are in the frequency range which produces a response in the ear can they be heard by man.

Sounds which have a sustained and simple character and do not seem to be a mixture of different sounds are called tones or musical sounds. Abrupt and sudden sounds which do not last long enough to convey any idea of musical pitch are noises.

Noise has two aspects. In one respect, noise is something which you sense - something that you feel inside, like a headache. You can hear noise and recognize it as a low-pitched rumble or a high-pitched whine, such as one would hear from a turbojet engine. In another respect noise is a form of energy in the air made up of invisible vibrations which enter your ear and cause you to hear. Noise can be defined as any irritating or unwanted sound. This elementary definition is remarkably sensible since it combines both aspects of noise: the energy outside the physical body, and the feeling inside.

Naturally, one man's music can be another man's noise, as might be the case when you cannot sleep because of your neighbor's hi-fi at full volume at midnight.

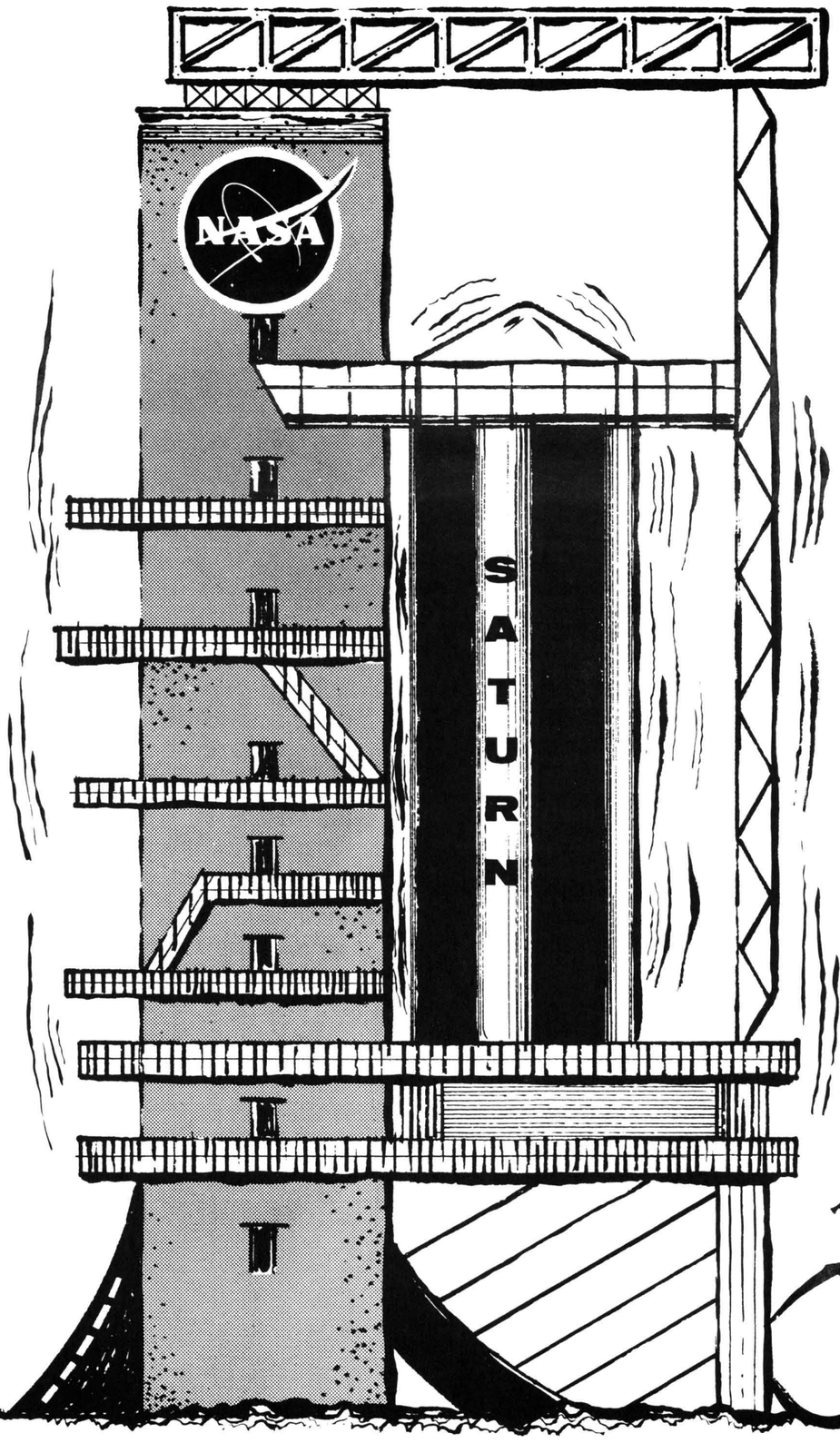


nature of noise

A noise source causes disturbances in the air with a tone quality or frequency characteristic (pitch) and a loudness or amplitude characteristic (intensity). The chart above shows how these are related. We can have high-pitched soft sounds, such as a woman's voice, or a low-pitched soft sound, such as a man snoring. Also, we can have a high-intensity, low-frequency noise such as the Saturn, and a loud, high-frequency noise such as a power saw in a woodworking shop. The loudness is described in decibels and the frequency is measured in cycles per second. The greater the number of decibels the louder the sound. The higher pitched the tone, the more cycles per second we have. Sound will also tend to be radiated in some directions more than others. For instance, a phonograph sounds different when one is directly in front of it than when one is to the side.

saturn noise

Thus, we come to the question: How does the Saturn make its noise and what are the characteristics of this noise? Sound is generated anytime there is a disturbance in the air. For instance, the wind blowing past poles and buildings will cause noise, or when air is blown into a trumpet, a tone is produced. The Saturn works in this same way when the high - speed exhaust from its engines strikes the air and causes a disturbance. All the sound is not generated at the nozzle, but it is radiated all along the exhaust where movement and disturbance exist. High frequency sound is produced near the exit of the Booster nozzle, while the lower frequencies are produced downstream of the nozzle all along the exhaust stream. The Saturn sound is predominantly low frequency because of the large volume of air filled by the exhaust where the low - frequency sound is generated. The sound is so loud because there is a tremendous volume of air moving at a great velocity in the exhaust stream.



how noise travels

Sound is communicated by compressive waves through material mediums. Sound waves travel in air similar to the way water waves travel when a stone is dropped into a smooth pond. As the waves travel away from the source (where the stone hits the surface of the pond), the speed of the wave across the surface remains the same, but the size of the wave decreases. When sound waves can spread out in every direction, the intensity or size of the wave varies inversely as the square of the distance from the source. In other words, the intensity (loudness) at 100 yards from the source would be four times as great as the intensity at 200 yards.

Knowing the characteristics of the noise source and how it travels, let us think for a moment about how the sound gets from the Saturn test stand to us. As the sound travels through the air, its characteristics change due to the condition of the atmosphere. As the noise travels away from the stand, upwards as well as along the ground, it spreads out and fills more volume and becomes weaker as it gets further from the tower. As a result of air propagation losses, noise loses energy from the high frequencies faster than from the low frequencies. Consequently, from a source several miles away it sounds like a low-pitched rumble.

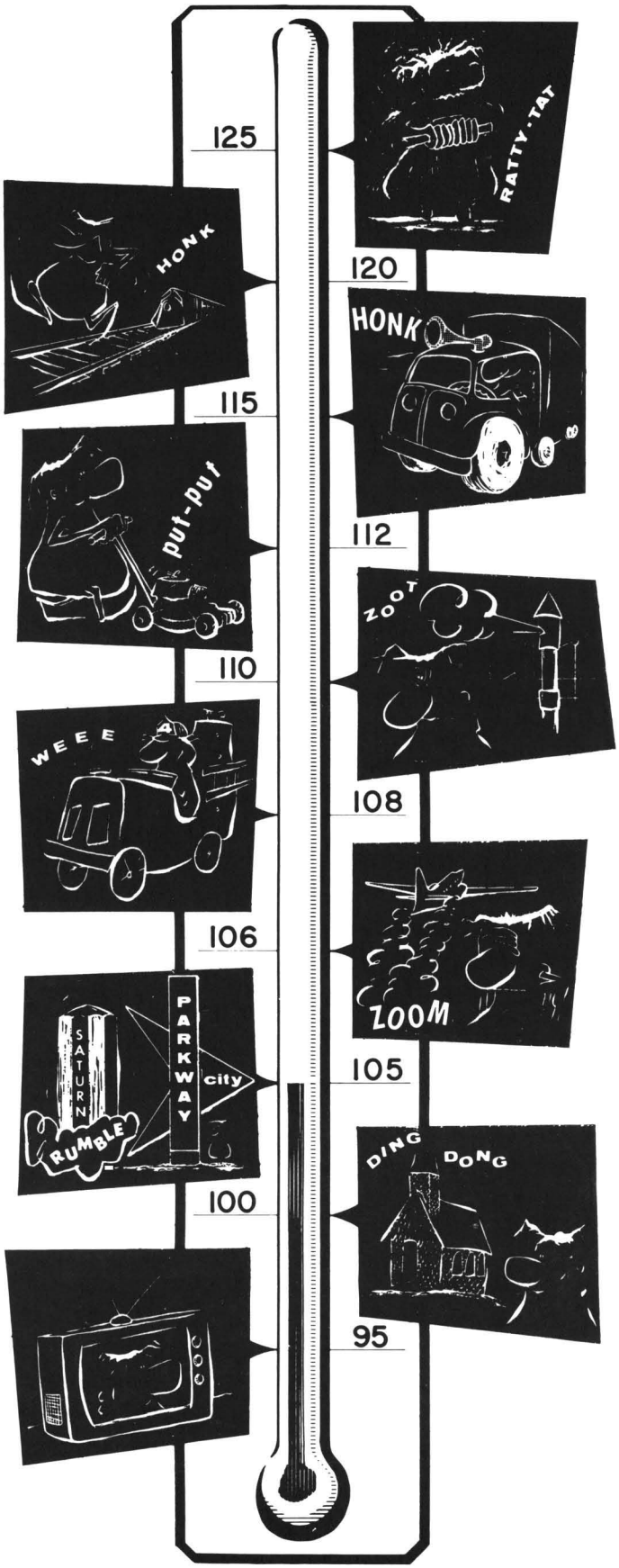
megaphone or focusing effect

A special problem that appears in conjunction with Saturn sound concerns the sound that travels up into the atmosphere from the test stand and is bent back to the earth at some area several miles away. Sound travels at different velocities at various heights above the earth due to temperature and wind conditions. As the rays of sound are bent or "refracted" back to earth, an area of sound of higher intensity than found in neighboring areas is temporarily created. This focusing can cause much annoyance and irritation and alarm the residents within the area.

msfc efforts to decrease noise

To alleviate the focusing situation, MSFC makes weather observations before each test run. Air temperature and wind conditions to 10,000 feet altitude are measured to determine if focusing conditions exist. The test run is delayed if the possibility of severe focusing conditions is found. As MSFC learns more about these problems we hope to avoid alarming anyone with our firings by appropriate test scheduling.

huntsville noise thermometer



effects of saturn noise

How loud is Saturn noise? To answer this question, we surveyed several domestic noises and compared them to measurements of Saturn noise recorded at the Parkway City Shopping Center in Huntsville.

As we can see on the "Huntsville Noise Thermometer," a good many noises can be more bothersome and detrimental than the Saturn noise. To show that buildings can take the noise from Saturn test firings, a mock-up house was built just 1, 200 feet from the Static Test Tower, and this house has withstood all the Saturn firings without a sign of strain or damage. The noise level at the model house is about 15 decibels above the highest point on the "Huntsville Noise Thermometer."

conclusions

This pamphlet was prepared to familiarize you with the characteristics of sound in general and of the Saturn noise in particular.

You should now realize that, although Saturn noise may irritate you occasionally for a short while during the static test firings, there is absolutely no cause for fear of physical harm or property damage.

MSFC will do everything feasibly possible to prevent excessive noise levels in residential areas during firings, and when new methods of suppressing noise are discovered anywhere in the country, MSFC will investigate the feasibility of utilizing these methods to advantage in suppressing Saturn noise.

MSFC should be considered an educational and financial asset to this community, and you should also accept the occasional, novel noises as necessary inconveniences and marks of progress in the space age.

PLOOP

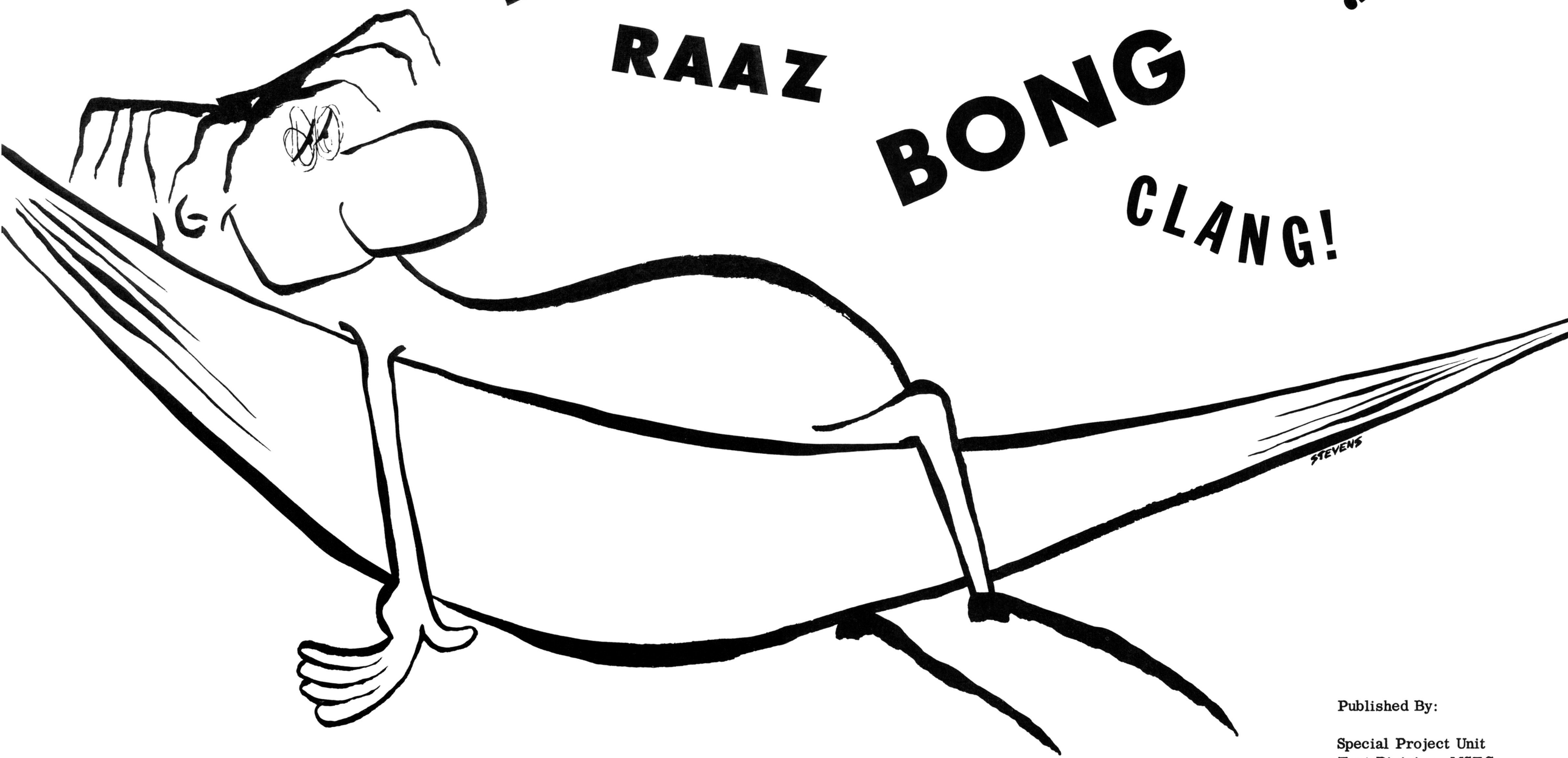
BAAROOM!

zoiinng!!

RAAZ

BONG

CLANG!



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