

A steel drum, or pan, has up to 32 notes, which physicists have found to pulsate with complex resonances. A laser interferogram, right, shows the result of increasingly hard beating of a middle G note

ments made out of oil drums and steel pans, produce a surprisingly rich array of harmonic overtones and couplings between notes that fuse to form haunting sounds fast catching on around the world.

Born in Trinidad, the steel drum or, as its creators call it, pan (pronounced "pon," like the Caribbean "mon" for man), is being increasingly heard not only in New York City, because of its large population from the Caribbean diaspora, but globally, because of its rich sound and relative ease of play.

Steel orchestras and steel-pan soloists are popping up in places like Stockholm and San Francisco, Tokyo and Toronto. Movie soundtracks, like Disney's "The Little Mermaid," feature steel pans. And

ment," he said in an interview. "As you increase the amplitude of an area that you're exciting, you get a lot of sympathetic vibrations."

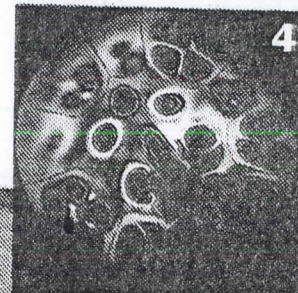
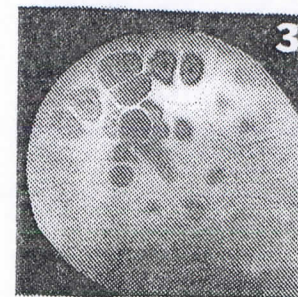
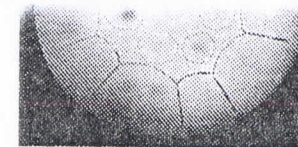
Writing in a recent issue of *Physics Today*, a monthly journal published by the American Institute of Physics, based in Woodbury, N.Y., Dr. Rossing, D. Scott Hampton of Northern Illinois University and Dr. Uwe J. Hansen of Indiana State University lauded the pan.

It is "probably the most important new acoustical (that is, nonelectronic) musical instrument developed in the 20th century," they wrote.

Dr. Rossing, a co-author of "The Physics of Musical Instruments" (Springer-

Continued on Page C8

A steel drum, or pan, has up to 32 notes, which physicists have found to pulsate with complex resonances. A laser interferogram, right, shows the result of increasingly hard beating of a middle G note. First (1) it vibrates alone. Then (2) the neighboring G note an octave lower, seen as double lobes, begins to vibrate in sympathy. Next (3) a low C note and other notes join harmonically in the chord before (4) the whole pan begins to radiate sound.



Source: Dr. Thomas D. Rossing/Northern Illinois University

Linda Rosier/The New York Times

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Good, and Subtle, Vibrations from Steel Drums

Continued From Page C1

Verlag, 1991), became so interested in steel pan that he not only analyzed it with lasers and other scientific tools but journeyed to Trinidad to study its roots.

There he visited instrument makers, sat in on steel-band rehearsals and attended the island's Panorama Steel Festival, a competition held during the Carnival season in which steel ensembles of up to 100 players and 300 pans compete against one another.

"It's the superbowl of Trinidad," he said.

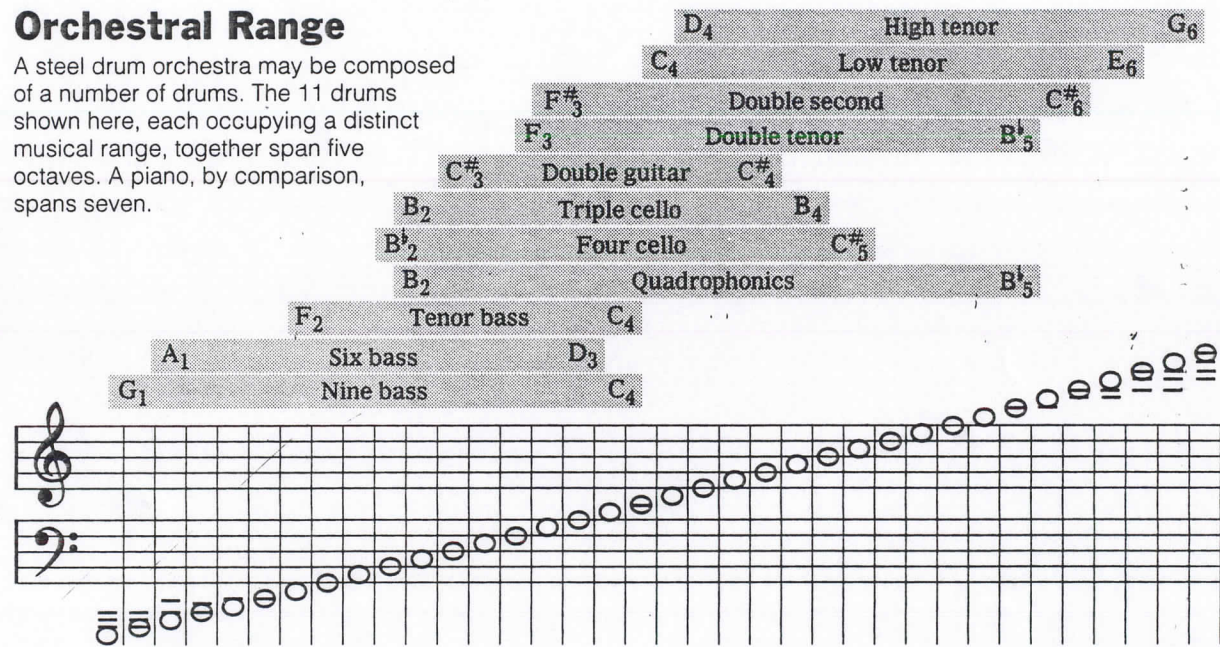
Trinidad and Tobago lie just off the coast of Venezuela and are rich in sugar cane and coconut palms, oil and rum. The nation, which won independence from Britain in 1962, is one of the Caribbean region's most prosperous.

Around the turn of the century, Trinidad's colonial rulers banned the playing of African drums during Carnival because the strong rhythms made with stout sticks often were followed by riots and bloodshed. So innovative Trinidadians took to playing buckets, frying pans, garbage cans, brake drums, biscuit tins and, eventually, oil drums. The first steel drums were rhythmic in nature, rather than melodic.

The main evolution of the instrument took place after World War II, as exhausted navies left thousands of 55-gallon oil drums on island beaches and as the celebrations of Carnival resumed with a vengeance, enhanced by the cheerfully hollow, percussive sound of the pan. It was born

Orchestral Range

A steel drum orchestra may be composed of a number of drums. The 11 drums shown here, each occupying a distinct musical range, together span five octaves. A piano, by comparison, spans seven.



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The main evolution of the instrument took place after World War II, as exhausted navies left thousands of 55-gallon oil drums on island beaches and as the celebrations of Carnival resumed with a vengeance, enhanced by the cheerfully hollow, percussive sound of the pan. It was born in the ghettos; for a long time, it bore a stigma because of its association with the poor.

Making a pan involves swinging a sledgehammer to pound down the end of an oil drum into a shallow concave bowl, which forms the playing surface. That is grooved with a metal punch to define the areas of individual notes, which are raised slightly in convex curves. After the pan is tempered over a wood bonfire, more hammering carefully tunes each note.

Notes are arranged around the playing surface in rings. On the outside, nearest the pan's rim, are large

Source: Physics Today

The New York Times

notes with low pitches, while nearer the center are smaller notes with higher pitches. A pan can have up to three sets of rings, with the notes of each ring usually an octave apart.

Arranged on one side of the playing surface are notes corresponding to a piano's white keys, and on the other side are the sharps and flats corresponding to the black keys.

Part or all of the oil-drum wall is retained in the manufacturing process and used as a baffle, which separates the top and bottom of the playing instrument and prevents the cancellation of radiated sounds.

Reverberations across the top of the pan are boisterous or gentle, depending on the force of the mallet strike. Part of the instrument's charm is undoubtedly the fact that rich music emanates from something that looks suspiciously like a garbage can.

Today's chromed pans, which can cost up to \$1,000, are a far cry from the rough ones that hung around the necks of the early inventors. They come in a wide variety of styles, with the bowl's depth varying from nearly eight inches in a tenor pan to four inches in a bass. Resembling full-sized oil drums, bass pans are usu-

ally clustered in groups around a musician.

According to Dr. Rossing and his co-authors, striking a pan with a mallet for a single note produces a sound spectrum rich in harmonic overtones, some originally tuned by the instrument's maker and others more fortuitous in nature.

A skilled pan maker, they say, tunes each note to have multiple variations of the fundamental frequency. This is achieved by subtle hammering within the note area. For instance, a C-sharp note will be pounded in a way that endows it with a harmonic at C sharp an octave higher. If possible, it will also be tuned to the third harmonic, which is G sharp. Such tuning in octave overtones, as well as with third and fourth harmonics, makes each note, in effect, a chord.

In addition to planned harmonies, reverberating notes often excite sympathetic vibrations in neighbors, further enriching the sound, the Physics Today authors said. For instance, striking a low B note in a steel pan will stir vibrations in the two nearby B-note areas at two higher octaves, along with their harmonics.

The rich sound spectra of a resonating pan note, as recorded by a microphone and revealed by an oscilloscope, a television-like device that displays raw frequencies rather than pictures, shows multiple and progressively smaller peaks of diverse harmonics. For instance, a C-sharp note was revealed to have six distinct peaks in frequencies of up to 2,000 Hertz, or cycles of vibration per second. A low G note had a total of nine peaks, like a miniature orchestra in a single note.

Dr. Rossing and his colleagues have repeatedly flashed laser light across the tops of vibrating pans in the laboratory to make holographic interferograms that reveal the various resonances atop the playing sur-

face. For instance, drumming harder on the area of a middle G note will provoke vibrations at the neighboring G note an octave lower. In an interferogram, the areas being beaten and resonating nearby appear as dark spots.

As the drummer pounds harder on middle G, the vibration spreads. "At typical performance amplitudes," the researchers write, citing the interferograms, "almost the entire drum vibrates and radiates sound."

Many secrets of the pan have yet to succumb to scientific analysis, experts say, because the instrument is still evolving rapidly and changing from one year to the next. The Trinidad Government has tried to standardize the pan as an aid to fostering an industry to produce the instruments. But folk artists keep coming up with new twists and variations.

"The steel pan is very much an instrument in development — new layouts, new crafting methods and refinements are tried by pan makers all the time," Ulf Kronman, a Swedish expert on the instrument who monitors global trends from Stockholm, said in one of his writings.

In Brooklyn, home of the annual West Indian Day Parade, armadas of steel pans and the biggest musical competitions outside Trinidad, experts said they knew and approved of the continuing scientific analyses, but they insisted that the magic of the instrument was intact.

"Nobody on the face of the Earth is going to take that away from us, no matter what," Anthony Abdul Reid, steel-pan coordinator at Crystal Music Productions, a Brooklyn-based company that runs education and training workshops, said in an interview. He added that the wave of creativity behind the steel pan was anything but exhausted.

"Our innovators are making slit pans, vibapan, fiddle pan, all kinds of things," he said. "This industry is going to explode in the 21st century."

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