

# The story of the compact cassette...

*It wasn't all sweetness and light!*

*Often seen as a model of cooperation in the world hifi industry, the Philips compact disc won acceptance only after some heavy "horse trading" and ironical twists of fate characteristic of the tape story as a whole.*



by NEVILLE WILLIAMS



*RCA's twin-spool cassette worked well but it did not appeal to enthusiasts and was too large and expensive for the home music market. (From "Tape Recording" by Walter G. Salm).*

In Australia, late last year, to talk about audio and video tape recording, Bill Andriessen, Chief Applications Engineer for BASF in Germany, was prompted to make a few observations about the early history of tape recording and the emergence of the compact cassette — something which he saw at close quarters as a member of the Philips, Eindhoven engineering staff in the '60s.

As an example of the early ironies in the development of tape, Bill Andriessen reminded technical journalists at a symposium in Launceston (Tasmania) that the earliest attempts to produce magnetically coated tape included the use of finely divided particles of metallic iron. It proved to be chemically unstable, absorbing oxygen and quite literally turning to rust.

As an idea, it was fifty years before its time and it is only recently that tape manufacturers have managed to contain pure iron particles in a binder that will ensure chemical stability — resulting in the much publicised pure metal tapes.

At the time, BASF chemists, who had been concerned mainly with the development of a suitable plastic base film, suggested that it might make better sense to concentrate on the use of "rust" in the first place, or at least gamma ferric oxide ( $Fe_2O_3$ ) which they knew to have interesting magnetic properties. They were familiar with it as a leading

manufacturer of chemicals and pigments.

The suggestion proved to be a good one and, in the 50 years since it was taken up, magnetic oxide technology has advanced so far that — ironically again — pure metal coating is finding it difficult to stage a comeback against modern oxide formulations, particularly one like BASF's own Chromdioxid Super II.

With much of the early development concentrated in Germany during the early '30s, it was not surprising that audio tape recording should find its first large-scale application in that country during World War II, as an adjunct to both internal and external radio broadcasting. Unaware of the progress that had been made, the allied nations could only wonder and speculate as to how the Berlin Philharmonic Orchestra could perform at night for German radio, despite the bombing and the blackouts!

It was only after the war that they woke up to the advanced stage of German tape technology and carried off an advanced model Magnetophon for detailed investigation. That much of the story has been told many times.

The Magnetophon used magnetically coated plastic rather than paper tape and a form of AC biasing that was an improvement on a basic patent that had



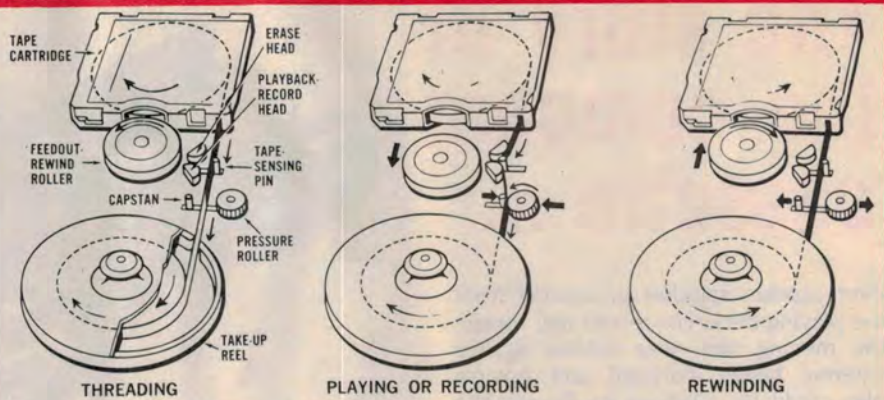
Akio Morita (left) and Masaru Ibuka, co-founders of Sony. According to "The Sony Vision", Morita forced Philips to sign a no-royalty agreement for their compact cassette system by threatening to do an alternative deal with Grundig and Telefunken.

been taken out in 1921 by two engineers from the Naval Research Laboratory in Washington D.C. Operating at a tape speed of 22.1ips, with a bias frequency of 80-100kHz, the frequency response was within 1dB from 25 to 10,000Hz.

In reality, the Americans and the British should not have been as unaware as they appeared to be of German progress in magnetic recording. Back in November 1936, the first major concert performance to be recorded on magnetic tape had taken place in BASF's home city: Ludwigshafen in Germany. It featured Sir Thomas Beecham and the London Philharmonic Orchestra!

It has since been suggested, rightly or wrongly, that magnetic tape recording was something that the powerful British and American record interests preferred not to know about.

More to the point, according to Bill Andriessen, the Americans need not have relied on a post-war intelligence "coup" to obtain the technology for further development. As evidenced by the recording session in Frankfurt, the



Devised jointly by CBS and 3M, this single-spool cassette system was easy to use but difficult to manufacture. It did not survive but it triggered Philips and Grundig into action.



magnetic tape system had never been regarded as a secret in Germany. Everything to do with it had been covered in patent documents progressively lodged in a number of countries, including Switzerland. All that was necessary was for somebody to look it up in the Swiss Patents Office!

Once tape technology got moving again, it was quickly taken up by the professional audio industry, worldwide, subsequently moving down-market for potential domestic use. But, while the novelty factor in this latter role was high, the basic clumsiness of the open-reel tape system became all too apparent. The tape slipped, and fell off the reel, and tangled and broke and, to make matters worse, users were presented with a confusion of speeds and formats.

Open-reel tape decks surged to about 10% market penetration and then faltered. Tape was too clumsy, too "technical" as an everyday domestic music source. Consumers had decided to stay with the disc!

Sensing this, a number of major companies set their engineers to work on ideas for simplifying and rationalising tape handling. It should not be necessary they reasoned, for users to handle or even touch the tape. Ideally, it should be contained in some kind of a magazine which could be placed on or in a tape deck, with the same facility as a disc.

Around 1956, RCA proposed a design which, in some respects anticipated the modern compact cassette. Inside, the tape was spooled between two hubs which, for purposes of drive, slipped

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over capstan spindles protruding from the playing deck. For record and replay, the moving tape was pushed against external heads. Forward and reverse play could be achieved by flipping the cassette over or, in a more complex deck, by the provision of bi-directional drive and additional heads. RCA claimed that the cassette could be slipped on and off as easily as a disc and that it would ultimately render the disc system obsolete.

Official release of the RCA cassette was announced in the July, 1958 issue of this magazine, with a follow-up article in August. The cassette turned out to be quite large (approx. 180mm x 130mm) being loaded with standard 6.35mm wide tape, operating at 9.5cm/sec — both figures borrowed straight from open-reel practice. It was a 4-track system but RCA missed out on the opportunity to rearrange the tracks to provide for possible mono/stereo compatibility, as with the ultimate Philips system. In the event, and despite RCA's initial optimism, the system did not survive in the marketplace.

Also of note, according to Bill Andriessen, was a system devised jointly by CBS and the 3M Sound Corporation, working under the general supervision of Dr Peter Goldmark, pioneer of the LP phono disc. This used quite a small cassette containing a single spool loaded with tape only 3.8mm wide. The player/recorder had to thread the tape automatically through to its own in-built take-up spool, and subsequently rewind it before the cassette could be removed.

It so happened that the CBS/3M unit had been designed as an automatic changer but it exhibited the most unfortunate tendency to load the waiting cassette before the last one had been disengaged! It, too, failed to win market support but, ironically, not before it had triggered Philips and Grundig in Europe into taking up the challenge on their own account.

The two companies had been negotiating with CBS/3M for joint manufacturing rights for their developmental cassette deck but were met by a demand for a down-payment of \$US1,000,000 plus a royalty on each separate deck and cassette. It was a substantial figure at the time and Philips/Grundig decided that, for that



*The Philips EL-3302 battery-powered portable, which did much to establish the compact cassette format in Australia.*

kind of money, they could fund a research program of their own.

This they did, coming up with a design that never got beyond the prototype stage! Like the CBS/3M unit, it used a small, single-spool cassette and automatic tape feed through the deck to the take-up reel. And, like the American design, it was sufficiently complicated to raise doubts — in some quarters, at least — about the wisdom of proceeding to the production stage.

At that critical point in time, another completely separate development team in Philips revealed the existence of an alternative design which ultimately provided the basis for the compact cassette system. But, said Bill Andriessen, "it caused a revolution in Philips ... an earthquake!"

Officially, the second team had been working on a tape dictation machine but the results were so promising that the team leader, on his own initiative, extended the development to ensure that the system could handle music as well as speech. With grave doubts about the official cassette development approach, he felt that his own project could well hold the key to what the Company had been seeking. He was so right!

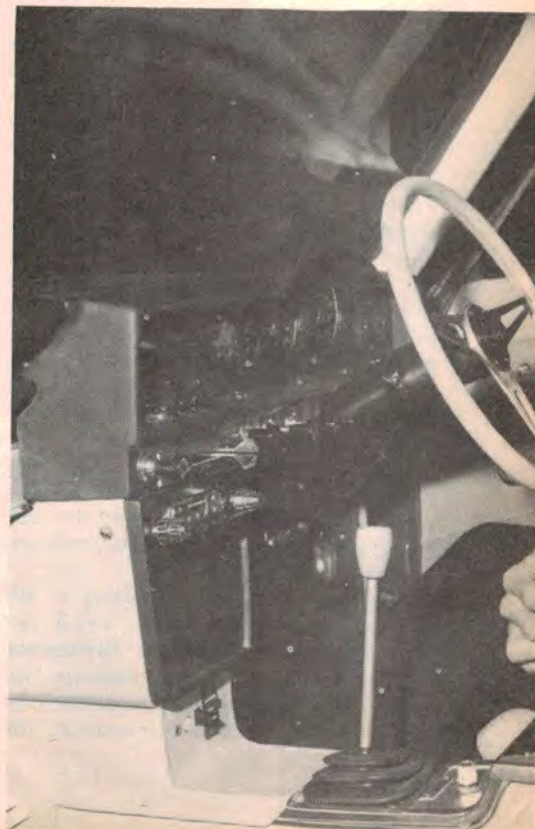
Notwithstanding the resulting "earthquake", it was clear to everyone who saw it, that the unofficial spin-off from the dictating machine project was the way to go. It was relatively uncomplicated to produce, easy to use, portable and economical and, in terms of sound quality, at least equal to popular portable transistor radios of the

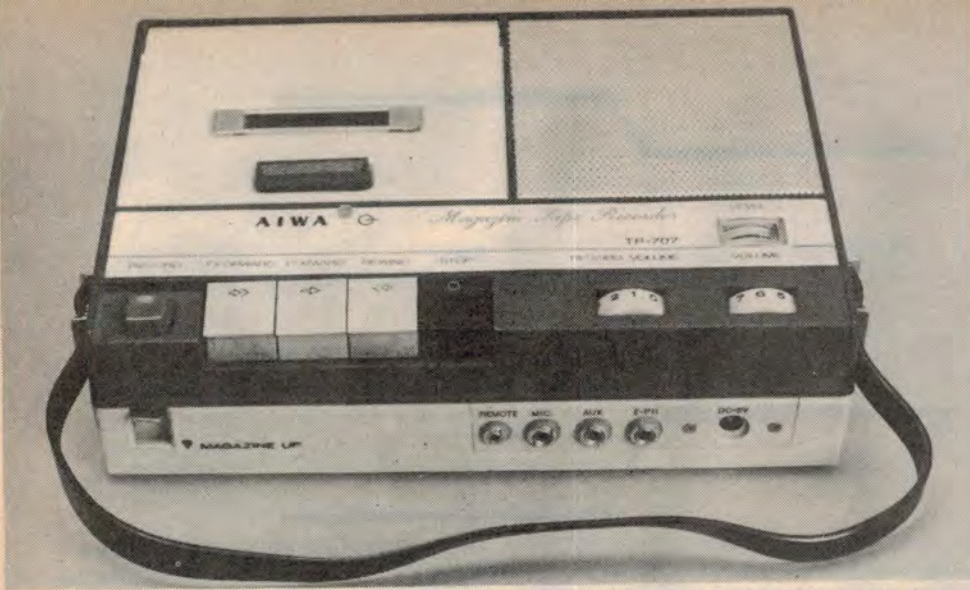
*In 1963, British racing driver Stirling Moss demonstrated this in-car stereo tape system. The cassette resembles the Philips design but leaves the tape exposed.*

day. What's more, it had the potential to appeal directly to the public, without first having to win acceptance from the tape enthusiast minority.

Unfortunately, when news of all this reached Grundig, they concluded that Philips had deliberately gone behind their back and, while supposedly cooperating in a joint project, had been secretly working on another approach. Grundig's response was to join forces with Telefunken in a development of a system of their own, which was offered to the Japanese and to Sony in particular, free of any royalty charges.

The "horse trading" had begun and further reference to it appears in the book "The Sony Vision" by Nick Lyons.





The Aiwa TP-707, claimed to be the first cassette recorder to be released in Japan. Within three months it was modified to accept the Philips cassette.

(1976, Crown Publishers Inc., One Park Avenue, New York, N.Y.10016.)

At the time, Sony's entire tape division was the responsibility of Norio Ohga, a personal protege of Akio Morita and directly responsible to him and to his co-founder of the Company, Masaru Ibuka.

When Ohga realised the potential advantages of tape cassettes over the reel to reel system, he foresaw that some such system would one day become standard throughout the world. So he began to canvass the possibilities of a standard format with other companies, including Philips, Grundig and Telefunken.

In due course, a representative of Philips turned up in Tokyo with details of their new compact cassette system, a recital of its advantages and an offer of a

licensing agreement based on a royalty to Philips of 25 Yen (then about 7c) per cassette. Scores of hard bargaining sessions followed with Sony and other Japanese manufacturers and the royalty was gradually whittled down to 2c.

Matsushita (National) signed at this figure but Morita insisted: "We must not have to pay that royalty".

Ohga duly went back to Philips and told them of Morita's decision. He pointed out that, if Sony chose to do a deal with Grundig and Telefunken on another format, free of any royalty, the Philips compact cassette system could not possibly survive. On the other hand, if Philips were prepared to sign a royalty-free agreement, said Ohga: "We will go along with your cassette, which will then definitely become the standard."

A year later, just such an agreement was signed but with Philips insisting as a condition, that all licencees must also sign an international standards undertaking. They also gained access to Sony's automatic recording level control circuitry, which made a further contribution to popularising the budget-level compact cassette recorders.

Once the die was cast, Philips launched the compact cassette with a will, their initial unveiling in the USA being at the

The photos below and at right shows Aiwa's first version of the compact cassette loaded with 1/4-inch tape. How did Aiwa pick this format and why didn't it become the standard?

New York High Fidelity Show in 1963, with the 2-track mono "Carrycorder".

In Australia, their most popular early model was probably the EL3302, also 2-track mono player/recorder operating from five 1.5V "C" cells, and provided with external microphone with remote control switch. While open-reel enthusiasts regarded them as "toys", they were very efficient and effective toys, easy to use and giving surprisingly good results on both speech and music. Their acceptance left little doubt as to the future of the format.

It took a while for Japan's tape industry to get rolling, with AIWA claiming to have introduced Japan's first cassette tape recorder in September, 1964 - model TP-707. However, while it looks the part, closer examination shows that the cassette is thicker and loaded with 6.4mm tape. Four months later, in January 1965, the TP-707 was replaced by the TP-707-P, with the mechanism modified to use Philips type compact cassettes.

Obviously very active in the field, AIWA released the TP-1004 in February '67, claimed to be the world's first portable stereo cassette recorder. This was followed in '68 by the TP-1009, claimed as Japan's first stereo cassette deck for use in the home. As such, it would have been the first trickle of a flood!

Initially, the compact cassette system was seen as a purely medium-fidelity music source: something that could take



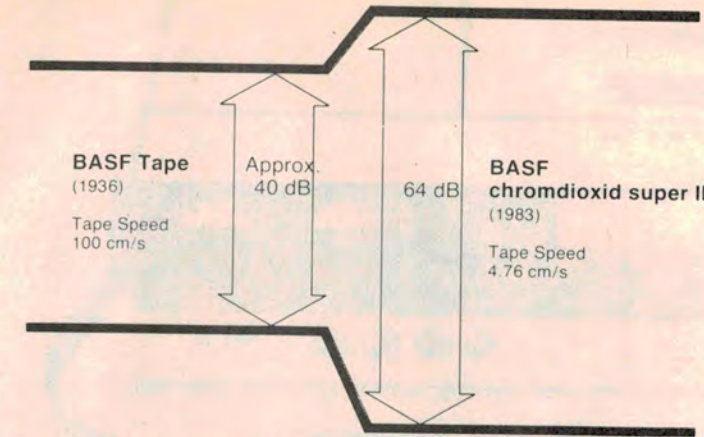
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its place alongside the average portable or car radio — pleasant but not pretentious. It can still fill that role when manufactured to a budget price but its potential has been extended upwards to a startling degree.

Fierce competition has inspired a continuous refinement in the design and production of tape heads and the associated circuitry, while a similar effort has gone into the transport mechanism to reduce wow, flutter and tape misalignment to the barest minimum.

Noise reduction systems have been evolved to minimise the one-time bugbear of tape recording — tape hiss. While not necessarily offering the largest figures, Dolby-B noise reduction is commonly given much of the credit for boosting the compact cassette system from medium-fi to a hi-fi source.

Tape manufacturers, too, have made a tremendous contribution and, while their publicity is studded with advertising



*From a BASF booklet, this diagram shows the increase in dynamic range between an old and a modern tape, despite a 20:1 reduction in tape speed.*

superlatives, jargon and ravings about single-decibel increments, they do add up to a very substantial improvement in frequency response and in signal/noise ratio for a given distortion level.

In a booklet made available at the time of Bill Andriessen's recent visit, BASF points out that they have now been involved in intensive research into coated magnetic tape for 50 years.

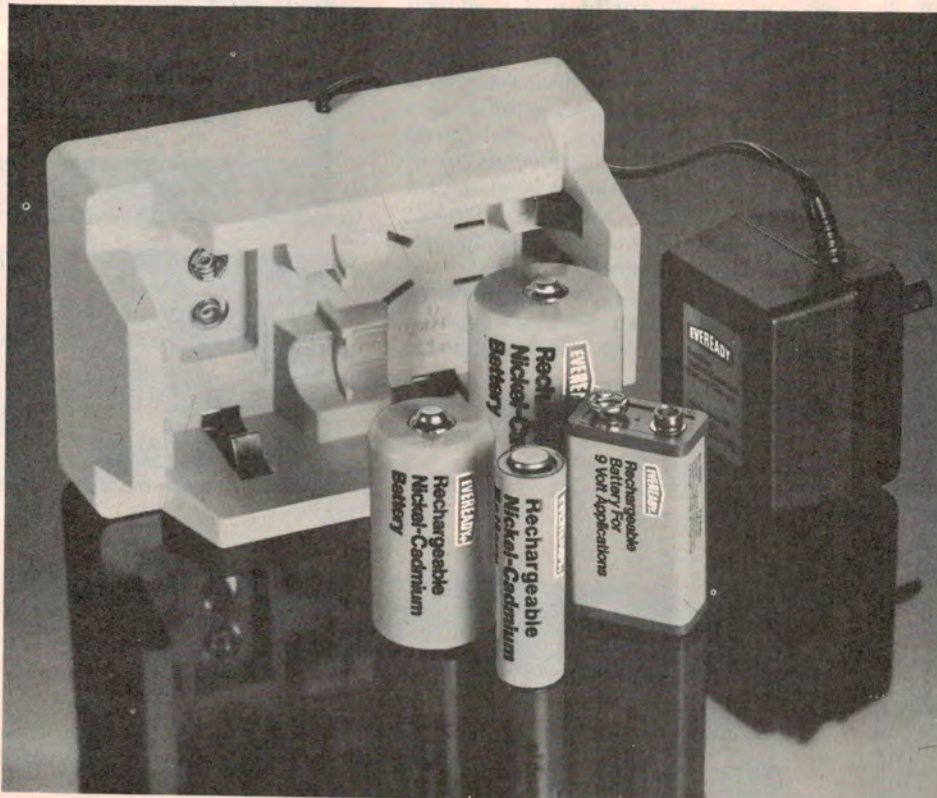
The historic Beecham/London Philharmonic recording in 1936 was made at a tape speed of 100cm/sec but, even so, the dynamic range available was a mere 40dB — the recording quality being roughly equal to that of 78rpm records of the day. In 1984, at compact cassette speed (4.76cm/sec) the dynamic

range available from BASF Chromdioxid Super II is claimed to be 64dB, before the use of noise reduction. With Dolby NR, BASF claim about 74dB, with the frequency response extending towards 20kHz, depending on the deck.

Indeed, the compact cassette enters 1984 as the almost universal medium, ranging from basic recorders, right through to a "must" in every domestic hifi system.

Yet it still can't escape those ironies. Refined to a degree that would astonish those who shared in the "horse trading" of the '60s, it now finds itself suddenly and positively eclipsed once again by its old rival: the disc. And, of all things, the compact disc!

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