Volume 1, Number 6 Spring through Fall 1978

The Audio Critic®

In this issue:

We summarize and update our previous reviews to bring them in line with our current findings and to provide a cumulative reference issue.

We review some exciting new developments in speakers, amplifiers, turntables and other components. We also set the record straight on some audiophile cult items that don't quite deliver.

We grapple valiantly with the unresolvable problem of "reference" systems.

Our famous (or notorious?) cartridge/arm/turntable alignment instructions are further elucidated.

And more, including the first installment of an audio purist discography.

The Audio Critic

Volume 1, Number 6 Spring through Fall 1978

Consulting engineers and other technical advisers are engaged on a project basis, some contributing under their by-lines, others working anonymously.

The Audio Critic® is an advisory service and technical review for consumers of sophisticated audio equipment. It is published periodically, at intervals ranging from two to four months, by The Audio Critic, Inc., and is available by subscription only. To maintain total dedication to the consumer's point of view, **The Audio Critic** carries no advertising by equipment manufacturers, distributors, reps, dealers or other commercial interests. Any conclusion, rating, recommendation, criticism or caveat published by **The Audio Critic** represents the personal findings and judgments of the Editor and the Staff, based only on the equipment available to their scrutiny and on their knowledge of the subject, and is therefore not offered to the reader as an infallible truth nor as an irreversible opinion applying to all extant and forthcoming samples of a particular product. Address all editorial correspondence to The Editor, The Audio Critic, Box 392, Bronxville, New York 10708.

For subscription information and rates, see inside back cover.

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Publisher's Note

Well, we've finally succeeded. For the first time, thanks to a series of unforeseen delays, we can claim an elapsed time between two successive issues that fully equals some of the shorter intervals achieved by other noncommercial audio publications. Their longer efforts are still beyond our reach; in fact, with our first six issues published within a span of just over 21 months, we still seem to hold the frequency record, for whatever it's worth.

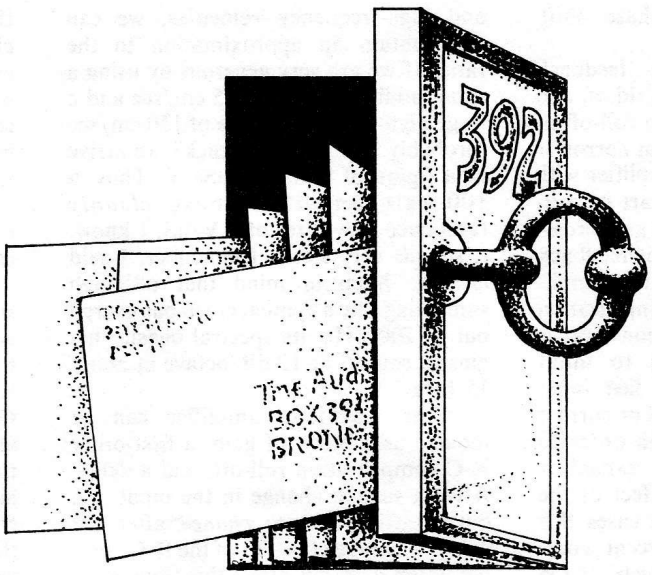
It should be quite obvious by now, with the large volume of equipment that passes through our laboratory and listening room, with our double-barreled measuring/listening approach to testing, and with our tiny staff, that we simply cannot be a bimonthly as originally planned. Not yet, anyway, and when we finally do get there, our format will have to be somewhat different. Some of our subscribers don't fully realize what a stupendous bargain our present format is, as we couldn't possibly cram as much new knowledge and cumulative test information into each bimonthly issue as we do now into our more slowly incubated issues. Yet the price per issue is the same.

More important than all of the above is the basic question about any audio review: how good is the information it prints? Frankly, we don't know of any publication in the audio field other than our own that combines total outspokenness with adequate know-how. One or the other, yes, but not both. The tiny handful of equipment reviewers with a good grasp of the necessary technical and listening criteria are under editorial restraints of one sort or another; the sock-it-to-them undergrounders are almost uniformly untutored and too often dizzyingly wrong. Therefore, if you really want to know which is better, component A or component B, and exactly why, we have the presumption to believe that you must come to us anyway, regardless of our publishing schedule.

We've taken some steps to speed up the work on our next issue, but our best hope for a faster schedule without any compromise in quality lies in an expanded staff, which in turn requires more capital, which in turn depends on more subscriptions. So the matter is ultimately out of our hands and back in yours. Because, in the deathless words of Sam Goldwyn, if people don't want to come you can't stop them.

Box 392

Letters to the Editor



By now our editorial correspondence has fallen pretty much into a pattern. We receive basically three categories of letters. The first consists of the I-love-you-you're-the-greatest and the get-lost-you-creeps varieties. (Not in equal numbers, we must hasten to add.) We publish very few of these, since there usually isn't much that our subscribers can learn from them. The second category addresses the various broad issues in audio on which we've taken sides and includes affirmations, disagreements, additional information and suggestions. These we publish whenever it appears to us that the letter writer knows what he is talking about or else represents an interestingly erroneous point of view that we consider worth refuting. Lastly, there are the letters from manufacturers in response to our equipment reviews. Our policy is to publish these without restriction, unless they are totally scurrilous and devoid of information. The letters we publish may or may not be excerpted, at the discretion of the Editor. Ellipsis (. . .) indicates omission. Address all editorial correspondence to The Editor, The Audio Critic, Box 392, Bronxville, New York 10708.

The Audio Critic:

In recent issues of The Audio Critic there have been several references to the need for low feedback factor and wide open-loop bandwidth in audio power amplifiers to avoid Transient Intermodulation Distortion (TIM). Although several papers have been written advancing such arguments, the subject is still quite controversial, and several authors have expressed opposing views on the subject. I would like to explain the following points: 1) feedback factor and open-loop bandwidth are, by themselves, irrelevant to TIM avoidance; 2) slew rate is the most important single key to TIM avoidance; 3) it is a common misconception that slew rate is smaller in amplifiers with high feedback factor and narrow open-loop bandwidth.

A typical explanation of TIM goes something like this: Feedback amplifiers operate on the principle that a large portion of the input signal is cancelled by feedback from the amplifier output, leaving a small signal-plus-error which drives the amplifier so as to produce the desired output. In amplifiers with large amounts of negative feedback, this signal-plus-error is forced to be very small and thus, in theory, low distortion results. The large feedback factor is obtained by putting a large amount of gain in the forward path of the "open-loop" amplifier. The open-loop amplifier is thus very sensitive and in fact will overload if the error gets at all appreciable.

All real amplifiers have finite delay. If a feedback amplifier is driven with a signal having a very fast rise time (like the leading edge of a square wave), there will be a brief period during which the open-loop amplifier sees the full input signal, undiminished by negative feedback which hasn't gotten there yet. Overload will thus occur and distortion will result. The more sensitive inputs of amplifiers with high feedback factors are that much more prone to such overload.

The situation is further aggravated by the slowness of response in the open-loop amplifier introduced by necessary feedback compensation. Each stage in a multistage amplifier contributes phase shift, which increases with frequency. Feedback compensation rolls off the open-loop frequency response so that the feedback factor falls below unity before enough excess phase shift accumulates to cause instability or peaking in the closed-loop response. In most amplifiers the gain is rolled off at 6 dB per octave with a single dominant pole. The frequency where the feedback factor falls to unity is called the gain crossover frequency and is usually in the vicinity of 1 MHz for power amplifiers. This constraint is primarily due to the power transistors, which have ft's of a few MHz and begin

to contribute substantial phase shift above 1 MHz.

Amplifiers with large feedback factors have more gain to get rid of, and must start their compensation roll-off at a lower frequency, resulting in narrower open-loop bandwidth. An amplifier with 20 dB of feedback needn't start its roll-off until 100 kHz for a 1MHz gain crossover, while one with 60 dB of feedback must start at 1 kHz. The latter amplifier, with heavier feedback compensation and a long open-loop time constant, is thus slower in responding to input signals. In responding to a fast input signal, a large internal voltage or current overshoot will be produced in order to charge the compensating capacitor quickly and overcome the effect of the long time constant. In some cases this overshoot may be 1000 percent compared to "nominal" signal levels. If the overshoot causes stages prior to the compensation to clip or become nonlinear, TIM results. When these overshoots are clipped, the amplifier is into slew-rate limiting; TIM is thus sometimes referred to as "slewing induced distortion." It has been shown mathematically that if the input signal is band-limited to a frequency less than the open-loop bandwidth, no overshoot can occur. Thus, wide open-loop bandwidth eliminates the possibility of TIM caused by overshoots. Having wide open-loop bandwidth, in turn, places a limit on the feedback factor.

The above explanation seems plausible enough and has been published in many forms in many places. It is the origin of the popular belief that small feedback factors and wide open-loop bandwidth are necessary for minimizing TIM. Although some of the papers on TIM have examined the above arguments in great detail and precision, some crucial considerations which alter the conclusions have been left out or dealt with inadequately. These include: 1) rise times of program signals; 2) propagation delay of real amplifiers; 3) design factors affecting overshoot magnitude and slew rate. There also seems to be a tendency to confuse rise time, rate-of-rise and delay.

The question regarding large-signal rise times of real signals is probably the most controversial, but we can get a handle on it by estimating the ratio of peak slew rate to peak amplitude for program signals. Assuming a phono source, we first recognize that for frequencies between about 500 and 2000 Hz, post-RIAA amplitude and recorded velocity are directly related. Above 2 kHz, post-RIAA slew rate and velocity are directly related because of the integrating effect of the 2 kHz RIAA roll-off. Assuming realistic values for maximum midband and high-frequency velocities, we can then obtain an approximation to the ratio. If we are very generous by using a small midband value of 25 cm/sec and a large high-frequency value of 150 cm/sec (probably impossible to track), we arrive at a figure of 0.076 (V/uS)/V. Thus, a 100-watt amplifier must *cleanly* reproduce slew rates of 3 V/uS. I know, it sounds very small. Remember, I said *cleanly*. Keep in mind that although something like a cymbal crash has energy out to 200 kHz, its spectral density begins to roll off at 12 dB/octave at about 15 kHz.

The open-loop amplifier can be molded as a block of gain, a first-order R-C compensation roll-off, and a delay. After a sudden change in the input, the output will *begin to change* after the delay. The time constant of the R-C compensation does not affect this time interval. The closed-loop amplifier is a linear system so long as these elements are linear. It is also a continuous system in spite of the delay. Feedback is present 100% of the time as long as no stages are clipped. There are no intervals during which the amplifier operates open-loop and exhibits increased gain. The feedback is, however, continuously "out of date" by a time equal to the delay. Fortunately, the feedback equations readily take this into account in both the frequency and time domains. Based on stability considerations, it can be shown that this delay must be typically less than 125 nanoseconds (45 degrees at 1 MHz).

Can a full-amplitude bandlimited input signal such as a square wave rise far enough in 125 nanoseconds to overload any stages preceding the compensation (usually just the input stage)? The integrating action of the compensation prevents later stages from overloading. A 2V-peak square wave bandlimited to 20 kHz (0.025 (V/uS)/V) will rise about 63 mV in 125 nsec. This is enough to drive some input stages into nonlinearity, but most high-quality amplifier designs have enough local feedback in the input stage to easily handle such a signal. Remember, this square wave is over three times as fast as the fast program discussed earlier. Feedback factor and open-loop bandwidth are not relevant here, since designs with different values for these could easily have the same input stage design and delay. The important criterion here is to have an input stage that can handle large input signals, at least under transient conditions.

We must now determine if the amplifier can keep up with the rate of change called for by the input signal without being driven into nonlinearity by internal overshoots. This is basically a question of margin against slew rate limiting, since slewing is the result when the overshoots are so big they are clipped. At this point it is important to emphasize that it is the *magnitude* of the overshoots which is important, not percentage; many papers in the literature have erred in emphasizing the latter. It should be clear that good margin against slew rate limiting guarantees that the overshoots will not be large enough to cause nonlinearity and thus TIM.

How does feedback factor affect slew rate? By itself, not at all. Let's take an example. Amplifiers with high feedback factors usually have the extra open-loop gain after the point of compensation. The most common example is the use of a current-source collector load on the pre-driver stage. Suppose this stage has a shunt capacitor at its input for compensation. If we double the gain after the compensation, we must double the value of the compensating capacitor to restore the gain crossover frequency to its original value. However, the added gain means that we now need only half the rate of change on the capacitor to achieve the same output slew rate, so the magnitude of the overshoot charging the larger capacitor is unchanged. The percentage overshoot is approximately doubled, however, because of the *smaller final value* at that node. Even though the roll-off starts one octave lower, the input stage doesn't have to work any harder to achieve a given slew rate. Similar arguments reveal the same result for other forms of compensation, such as Miller effect. Similar arguments also show that overload recovery time is not increased by a larger feedback factor.

Amplifiers with large feedback factor and small open-loop bandwidth thus slew just as well and are just as free of TIM as any others built with the same transistor ft's, given proper design. These observations are confirmed by measurements which Matti Otala conducted on some JFET operational amplifiers which had good slew rate. They showed extremely low TIM in spite of very high feedback factor and small open-loop bandwidth. Good designs typically require a slew rate margin of less than 4:1, while a really poor design (gross open-loop nonlinearity, asymmetrical slewing, etc.) might require 10:1. Based on earlier observations, a well-designed 100-watt amplifier should have a slew rate of at least 12 V/uS.

It is not surprising that many of the best-sounding amplifiers have low feedback factors, for they were probably designed by people who were highly aware of, and concerned about, things like TIM. In choosing a low-feedback design, they realized that they had to be infinitely more careful with the open-loop design. However, these excellent designs could be further improved with-

out penalty by the proper application of more overall feedback.

Finally, it is extremely important to keep in mind that the mechanism being discussed here (and in most TIM literature) is only one of many sources of high-frequency intermodulation distortion (TIM). Adequate slew rate does not guarantee freedom from TIM produced by other sources such as junction capacitance nonlinearity, output transistor charge storage effects, etc.

Very truly yours,
Robert R. Cordell
Tinton Falls, NJ

This is altogether the most clear-headed presentation of the subject we've seen so far, and we find it absolutely unexceptionable as far as it goes. What we're not ready to concede—not yet, anyway—is that feedback causes no audible degradation of the signal whatsoever, even if it need not be guilty of slewing induced distortions. The "out-of-dateness" of the error-correcting signal presented to the input may be a broader and more troublesome issue than is generally admitted, unless the front-to-back delay is truly minuscule, as in a good tube amplifier (e.g., the Futterman). In typical solid-state circuits the delay may be responsible for subtle time modulations. See also our comments on the no-feedback Rappaport AMP-1 in this issue.

—Ed.

The Audio Critic:

After reading your articles on tonearm geometry, I set up the arm I was using at the time, a Grace G-704 unipivot with Supex MC cartridge on a Linn-Sondek turntable, and felt that I could hear an improvement. I then tried the same experiment using the G-707 arm in place of the 704 arm with the same cartridge and turntable. Again audible improvement. Not so much between the two arms but between the manufacturer's setup procedure and The Audio Critic's procedure.

Because of the difficulty in carrying out really accurate tests subjectively in a purely domestic environment (I believe it is very easy to subject oneself to a psychological snow job when dealing with audio equipment that you have made a major financial decision over), I wrote to Hi-Fi News magazine in England about your article. Hi-Fi News along with The Audio Critic is a magazine which I have a great deal of respect for, and I had hoped that they might try the setup procedure you outlined and review the result for me. A copy of your article accompanied the request.

Their response was very prompt and, as they suggested, I have forwarded a copy of their comments. The section where they disagree with your argument appears to be quite persuasive and I would appreciate your reaction. I have incidentally repeated my request that they try your setup procedure and let me know the subjective results.

Yours faithfully,
Bill Carter
Kalamunda, Australia

The letter to Mr. Carter from John Crabbe, the chief Editor of Hi-Fi News & Record Review (Britian's premier journal for serious audiophiles), follows.

Dear Mr. Carter:

Thank you for your interesting letter of June 8th together with the copy of the article from The Audio Critic. All your points are noted with interest but I must offer a few remarks about the article, since I believe it contains one rather serious error.

Although I would not necessarily dispute the claim that quite small errors in tracking angle can be heard (indeed, I have suspected for some time that some of the changes in quality across a disc arise from the changing error with a pivoted arm), I cannot for one moment accept the notion that this is due to a timing error between the two grooves rather than because of old-fashioned harmonic or IM distortion. The article proceeds very sensibly through the argument up to the point where the matter of linear displacement of stylus contact is discussed in detail. Here, it completely loses sight of the fact that such errors as there may be are derived from the final angular displacement between the true radial path and the actual stylus motion path. I must confess that I have not worked through the maths as I am rather busy at present, but I suggest that you make a simple sketch of a groove viewed from above, draw in a line at right angles to represent the correct stylus motion path, and then another line angled away from this by, say, 3° (which should represent the sort of conditions we are talking about). Now, if you put some dimensions in relating to the groove width, you will see that only at the very highest audio frequencies will the contact point on one side of the groove be displaced from that on the other by more than the tiniest fraction of a wavelength. Also, the 5-micron displacement (what they call '5% time modulation') again represents such a ridiculously small fraction of the 100-micron wavelength that one would have to sit with one's head in a rigid clamp exactly equidistant from the two loudspeakers before one could begin to consider the audible consequences of such an error.

There is also the point that from about 4 kHz upwards all the evidence on stereo perception suggests that the relative phase of the left and right signals (or their absolute arrival times up to a certain limit) is comparatively unimportant, while of course at lower frequencies the effects under discussion represent left/right differentials dwindling into total insignificance.

The upshot of all this is that while I agree that the errors in question could produce sufficient nonlinear distortion to be audible, I must regard the time thesis as a complete red herring. Incidentally, on the matter of vertical tracking angle, a composite review of cartridges, to appear in our July issue, offers measurements of both harmonic and IM distortion arising from vertical modulation, and finds a significant relationship with the effective vertical tracking angle.

Thank you again for raising this whole topic, and please feel free, if you wish, to send a copy of my remarks to the Editor of The Audio Critic. I would not wish to intervene directly as from one magazine to another, but if you wish to quote me on the subject by all means do so. Of course, you may disagree with my argument and send a string of maths back to me!

Yours sincerely,
John Crabbe
Editor
Hi-Fi News & Record Review
Croydon, England

It surprises and even saddens us to see Mr. Crabbe react with casually condescending speculation to something that isn't a trendy new idea advanced by us but has been rigorously worked out by some very distinguished practitioners and widely accepted for many years. In his 37-year-old seminal paper on tracking error, H.G. Baerwald clearly states that the effect of such error is a frequency modulation of the signal by itself, resulting in the generation of sidebands. He also states that the spectral character of these sidebands will create a larger nuisance effect than the harmonics of ordinary amplitude distortion. Although he doesn't use the modern term "time-dispersive," that's what FM is, isn't it? In the stereo era, the equally important work of Bauer, Cooper, Woodward and White all deals with FM-type distortions (specifically FIM and FXM) in connection with vertical tracking error. Thus it isn't our "time thesis" that's "a complete red herring" but rather Mr. Crabbe's inexplicable rewording of our simplified explanation of the subject as a "timing error between the two grooves." No sir, we weren't talking about the arrival times at the ear from the two stereo

speakers but about the audibility of FIM and FXM distortion (i.e., time-dispersive automodulations of the signal) in comparison with "old-fashioned harmonic or IM distortion." It is possible that this basic research isn't available in the library or files of Hi-Fi News & Record Review?

—Ed.

The Audio Critic:

I read issue #5 of The Audio Critic with great interest as well as raised eyebrows.

At the end of your Dayton Wright review you state: "Those who feel that the Bryston causes peaks and ringing in the Dayton Wright, whereas the Threshold does not, are invited to send us their revisions of the laws of physics for immediate publication."

I have no intention of revising the laws of physics, nor do I intend to defend the Dayton Wright/Threshold (I don't own them and don't intend to buy them). What I intend to do is to revise your interpretation of the laws of physics. It is an undeniable fact that for every action there is a reaction.

You should be well aware that the Dayton Wright is a very difficult load to drive. Such a difficult load can cause an amplifier to *act* in a strange manner, in turn causing the speaker to *react* to its input.

I have done quite a bit of work in the area of amplifier stability (I have designed a tube power amp as well as a tube preamp for the Win cartridge —neither of these are presently commercially available). By making a simple change in the output stage of my amplifier, thus making it unstable at high frequencies, I can make my little Rogers exhibit headache-producing ringing. This is in complete accordance with the laws of physics. For every action there is a reaction.

Thank you for taking the time to read this letter. I hope that I have shed some light on the subject.

Sincerely,
Craig Herberg
Falls Church, VA

Your point is well taken as long as you take our *point totally out of context. Deliberately misunderstanding someone you wish to differ with is an old dialectical ploy.*

In context, however, the following givens enter into the discussion: (1) the Bryston 4B was reviewed by us in issue #4 as an amplifier especially distinguished by its ability to drive the most complex reactive loads without batting an eyelash and (2) the Dayton Wright review characterized the speaker as having specific and discrete frequencies of ringing, several of which coincided with huge amplitude peaks.

To conclude from this that, who knows, the Bryston could after all be unstable and the Dayton Wright okay requires a strong desire to punish us for having made the provocative statement you quote. We refuse to be so punished by someone we believe knows exactly what we meant.

—Ed.

Speaking of deliberately misunderstanding people, at least a little, in order to set the scene for interesting dialogues as well as monologues, the master of the genre turns out to be none other than our old friend, Professor Greiner of the University of Wisconsin. Among other things, he has sent us a Xerox of a lengthy communication to Andy Rappaport, in which he nitpicks, corrects and virtually grades Andy's long letter published in our last issue as if it were a term paper by one of his students. He has also bombarded us with numerous marginal notes on our own published comments, the gist of his general attitude being "sez who?" and "prove it." In one of his jottings, for example, he feigns innocence of some of the basic writings of Bode on certain aspects of feedback to which we made glancing popular reference and challenges us "to present your 'mathematical' theory, if any, to the public." Come on, professor, why should we paraphrase, print and mail at our expense material which is available in your own engineering-school library? We're a consumer publication, not a university seminar.

Just as a quick sample of Greineriana, we're publishing below a letter written in response to one of our interpolations into Dick Majestic's letter about the RAM 512 power amplifier. The relevant part of the RAM letter said: "I can only suggest to you that you try the difference signal check. All that's necessary is to sum the inverted output signal with the input signal after readjusting for the amplitude difference and look at the resulting difference signal." Whereupon we parenthetically interjected: "Ah! But you have to look at both voltage and current differences!—Ed."

The Audio Critic:

The parenthetical comment marked is nonsense. The input current to a power amplifier is totally irrelevant. Power amplifiers are designed as voltage amplifiers with high and resistive inputs.

The amplifier is made to look like a voltage source to the load and thus it is the voltage transfer ratio that is important. It is the voltage transfer ratio that can be easily measured with the technique described in the letter. This happens to be a very excellent and fundamental measuring method.

The output current of a voltage amplifier is determined by the nature of the load and while it is of interest, it is secondary to voltage. Loudspeakers are designed to work from voltage sources.

If the amplifier fails to provide the current called for by the load, the voltage at the output will show this fact.

I am rather concerned that in your quickness to make a comment every little while in these letters, you are not being careful about them. This will eventually damage your creditability.

My high hopes for the technical soundness of The Audio Critic are wavering.

Sincerely,
R.A. Greiner

Thus is the straw man set up with a bit of deliberate misunderstanding. "We must speak by the card, or equivocation will undo us," says the Bard. Professor Greiner is implying that we need to be convinced of Ohm's law, namely that $I=E/R$. We already believe that, but while he is looking for evidence of academic delinquency we're looking for good, practical bench tests of amplifiers. With transient test signals and real-world reactive loads capable of energy storage. (Like, for instance, loudspeakers.) And under those circumstances it happens to be quite practical on occasion to bring out the current probe. It just might show something about the behavior of the amplifier that wasn't obvious with the voltage probe. Not because Ohm's law doesn't work but because of the way nonlinear reactive loads work.

We therefore feel that "nonsense" and "wavering . . . hopes for the technical soundness of The Audio Critic" are somewhat unfriendly. Not to mention "creditability," which is not only unfriendly but also a solecism. Why, oh why must one of our longtime academic heroes send us pictures of his feet of clay?

—Ed.

The Audio Critic:

I have just finished watching a very interesting and enlightening show on educational TV which brought one up-to-date on computers. Most pertinent was a computer which is able to diagnose over 800 diseases from over 2500 different symptoms. The abilities of computers to analyze, design, and even assemble seem almost limitless. Considering your obser-

vations about speakers and their design, and about your correlations between tests and your own subjective likes, it seems to me that it would be possible to feed all the necessary data into the proper computer and come up with an "ideal" speaker design—which could include everything from size, number and kinds of drivers, crossover networks, proper time/space coherence, etc., etc. I do realize that computers already play a very large part in the production and design of audio equipment, but with *your own* findings and the right contacts in the computer world you fellows should be able to come up with a most interesting, if not incredible-sounding, speaker system.

What do you say?

Sincerely,
Stewart Glick
Rochester, NY

We refer you to the article by Bruce Zayde in our second issue (Vol. 1, No. 2, pp. 28-31), in which he states that all the mathematical linkages between the relevant parameters of low-frequency speaker design can be programmed into a computer and correct solutions extracted at will. This is not true for the higher frequencies; the mathematical models involve extremely complex problems in membrane physics, and the equations are monstrous beyond belief. To the best of our knowledge, complete mathematical models of full-range speaker systems and computer programs for designing full-range systems based on such models have not been devised yet. We have seen a program for woofer designs and can report that it works very nicely. Computer-aided design is becoming fairly common in the speaker industry, but it isn't applicable across the board. Needless to add, computers don't have the answers to fundamentally unsolved problems; they can only supply existing answers faster.

On the other hand, regardless of the possibilities of computerized design information, ***The Audio Critic*** *is definitely interested in putting together a better system than anything available today at any price. (See also the article on reference systems in this issue.) We may end up having to fabricate at least a few parts of such a speaker ourselves, though. And we're virtually certain that the only moving-coil driver in it, if any, will be the woofer. The rest will be strictly force-over-area. That much we know at this juncture even without computers.*

—Ed.

The Audio Critic:

I suppose that as many people write you about what shape or format is best for your magazine as tell me at the end of a concert or workshop what aspect of my career I should pursue.

I find one lack of consistency in the pursuit of your goals. The problem is that your definition of advertising is a narrow one. That is that you accept no advertising by "manufacturers . . . or other commercial interests." Fine, no criticism of this policy. Yet in the loose sense a published letter on a technical matter, or indeed philosophical as in the case of Andrew Rappaport's letter redefining a way of looking at distortion, is, even without your commendation ("Thank you, Andy . . . "), 100% advertisement, albeit general and unsolicited. You must realize that at least subliminally, if not overtly, you are giving us not only objective reviews but the feeling that we can wait and expect something great to happen (which hasn't really happened yet).

Your review is obviously Gordian knotted on the Rappaport subject. How can you say that "it did extremely well, giving all comers a hard time in A-B tests" and say also that there is "a barely perceptible thickness . . . in the midrange"? That it "has become ultra-smooth and listenable in the upper octaves; we prefer it even to the Hegeman in that respect" but yet that it was "squeezed out by the new generation"? So you essentially gave the designer top billing and the product confused billing.

Are you taking credit with these mealy competitive adjectives for inspiring a mature 20-year-old to run faster to clobber Mark Levinson?

In sum I find that letters speak for themselves without your lucid interjections, and the credibility of your stating "no advertising" would be in no jeopardy if your irrelevant congratulations or antic endorsement of an idea were omitted. This would make for more cohesive and powerful editorialship. Comment after an article—don't interrupt even a jackass's train of thought. They and you speak for themselves.

Best Wishes,
Steven Silverstein
Player-Instructor-Designer
of Wind Instruments
Stony Point, NY

You've got it all mixed up, Steven. We accept no advertising, not because the commercial message might influence you *but because the money might influence* us. *We thought that was clear to every one of our subscribers, but it appears from your letter that it isn't. We want to influence* you *profoundly and we'll make every editorial attempt to make you see things the way we do. That's what critical reviewing is about. If we believe that Andy Rappaport is a very bright young man, or that some other audio designer is an orifice where the sun never shines, we'll make an effort to imbue our subscribers with the same belief. And that has nothing to do with impartiality in equipment testing. Should Andy come up with a lousy design, we'll say so—and he knows it. On the other hand, if he paid us at a certain rate per page or half-page for advertising . . . Get the picture?*

As far as conflicting qualities in a piece of equipment are concerned, we can't help it. That's the way it is. If a single preamplifier had the best highs, midrange and lows, the lowest noise, the clearest detail, the best construction, etc., etc., there'd be no problem. In this imperfect world, however, we have to point out the trade-offs and then filter our top choice through our own structure of values.

Your criticism boils down to two things: (1) that ***The Audio Critic*** *has strong opinions, which it injects wherever it can and (2) that even this opinionated critic hesitates sometimes when choosing the "winner" in topflight competition. On both counts, you're absolutely right.*

—Ed.

The rest is back talk from manufacturers in response to reviews in the last issue.

The Audio Critic:

It is an unusual task to respond to three reviews at once, particularly when one review is quite favorable and the others quite the opposite. But here goes.

First of all, thank you for the review of Sleeping Beauty Shibata. Your findings concur with those of many other critics. Perhaps if you had auditioned it through one of our Goliath II moving-coil cartridge preamplifiers you would have liked it even more.

Now to Grandson. It is difficult enough to understand the subjective terminology used to describe the sound of components without dealing with such subjectivity where it is not necessary. I am referring to such expressions as "(Grandson shows) an unhealthy amount of ringing with capacitive loads." How much is unhealthy? 5% overshoot? 10%? All amplifiers which use feedback will ring into capacitive loads. Grandson does not ring any more than most other amplifiers; in fact, it rings less than most.

Grandson is certainly not current-deficient. To quote from your review of the ML-2 in the same issue, "You can't call any amplifier with a 10-ampere peak current capability a little amplifier."

Grandson has 11 amps peak. That aside, the fact that Grandson is able to double its 8-ohm power output into 4 ohms, and triple it into 2 ohms, indicates a sufficient power supply. Grandson uses the identical power supply as Son of Ampzilla, with a lower voltage transformer.

Again, back to subjective terminology when it is unnecessary. What does it mean that you found Grandson's distortion figures "far from impressive"? What exactly does "some peculiar cross-coupling effects" mean? You shouldn't be afraid to quote your measurements. Perhaps if you had, we could discover that your sample of Grandson was defective, or had some minor problem. Or that it was behaving normally. As it stands now, we have no way of knowing what exactly caused the problems you experienced.

As far as Thalia is concerned, your opinions of its sonic qualities run contrary to our experience, and the experience of our customers. We will simply state that the unpleasant sound you report cannot be attributed to a properly functioning Thalia (or Grandson).

For proof of this we can only ask that readers of The Audio Critic audition these products themselves in the best acoustical environment available. Readers who are interested in reviews of Thalia and Grandson which come to opposite conclusions from those of The Audio Critic are invited to write to GAS.

Sincerely,
Adam Zareba
Vice President, Sales
& Marketing
GAS
Chatsworth, CA

(1) Even if Goliath II is the perfect moving-coil pre-preamplifier (which we seriously doubt), it can't be as good as an equally perfect transformer. (See Vol. 1, No. 5, p. 57.) It's quite possibly better than a mediocre transformer, but that's not the kind we use.

(2) Grandson does ring more than most amplifiers. The overshoot into a 2-microfarad capacitor across the load resistor is at least 100% and the ringing is undamped. What's more, a similar signal of lower amplitude appears at the output of the undriven channel. Is that the non-subjective terminology you were looking for?

(3) Maybe Grandson isn't current-deficient in the grossest sense, but it's certainly a lot cleaner into 8 ohms than into 4 or 2 ohms.

(4) We did give a specific example of Grandson's distortion figures.

(5) If either the Grandson or the Thalia hadn't been properly functioning, you would have been able to determine that when the units were returned to you.

—Ed.

The Audio Critic:

In regard to the model 3100 preamp report in The Audio Critic #5, we wish to make the following comment. We hope that it will be run *unedited* in the next issue.

The results obtained by The Audio Critic on the 3100 Ace Audio preamp *do not agree* with those obtained in other magazines, where the reviews were done by other veteran reviewers of many years experience. If any of your readers are interested in seeing these reviews, we will be pleased to send copies upon request.

A number of our customers, or prospective customers, have called to tell us that they have compared the 3100 or 3000 preamps to very expensive preamps costing over $1000 and some lesser ones, and have been unable to tell which is playing. These tests have been done in the comfort and leisure of their homes, under relaxed and intimate listening conditions with familiar records, etc.

In view of the discrepancies obtained in your test, we are requesting an immediate retest under carefully controlled conditions, and we hope that we may be allowed to participate in some of the sessions.

Thank you.

Yours truly,
John Grauer
President
Ace Audio Co.
East Northport, NY

The main reason why many thousands of audiophiles subscribe to ***The Audio Critic*** *is that the recommendations of "other veteran reviewers of many years experience" are unreliable. If our findings duplicated those of other publications, there would be no need for our services. Specifically, in the case of preamplifiers, reviewers who don't align their reference cartridge and arm for optimum lateral and vertical tracking geometry can't possibly come to a valid conclusion about the sound of a phono preamp. The same goes for "customers . . . in the comfort and leisure of their homes."*

As for a "retest under carefully controlled conditions," we would first like to be told what was wrong with the conditions specified on pages 49 and 50 of our last issue. Were they carelessly controlled or was their main fault that they didn't result in a higher ranking for the Ace 3100?

One more thing. We're curious to know why John Grauer considers his letter so devastating that he feared we might run it edited.

—Ed.

We saved the rarest gem of our collection for the last. Judging from the salutation, it may also have been sent to, or even published by, others.

An Open Letter to Peter Aczel, Editor and Publisher of The Audio Critic (Enquirer):

In reference to your review of the Hartley 24" subwoofer, which appeared in your magazine, Volume 1, Number 5, I want to state for the record that it is highly unethical for any magazine to review a product listing a manufacturer, when in fact that product in review was constructed by someone else. This, of course, is the case . . . the subwoofer system you tested was not manufactured by Hartley Products Corporation. I have also noted that in almost every other review in your last two issues, the product was obtained from the manufacturer or authorized distributor. Question-Why not ours? Although this fact would end your review before it began, I feel I must comment on your rather pompous approach approximating a review.

The Lab Measurements:

I have noted your laboratory instruments described in Volume 1, Number 4. Although your equipment is not significantly different from any good warranty station, I am amused that you see yourself as the "Audio Messiah", able to comprehend all mysteries behind frequency and time. After all, you said ". . . even so, we're convinced that if every speaker manufacturer routinely performed our simple tests (as we know for a fact nine out of ten don't), speaker design would be a far less haphazard affair today and the art would advance more surefootedly." Since there are, at last count, approximately 200 nationally branded speaker companies, I would like to receive your list of those 180 speaker manufacturers that don't follow Peter Aczel's easy method of measuring loudspeakers.

The Listening Test:

For the record, you state in your masthead that The Audio Critic represents the personal findings and judgments of the editor and staff. Before measuring you (and presumably, your ". . . even so, we're convinced that if every speaker manufacturer routinely perance was. I quote, "We suspect that the vast majority of audio practitioners, whether on the manufacturing or the reviewing end, have never really experienced the startling clarity of a system

with optimized time-domain characteristics from stylus tip to speaker diaphragm. Seasoned audio people who visit our sound room are invariably astonished, although we don't do anything there that they themselves couldn't duplicate if they ordered their priorities as we do."

As our newly anointed Messiah, we think you owe it to struggling audiophiles everywhere how we, too, can reach this nirvana. By the way, a list of your disciples might help to enlighten us as well.
The Admonitor:

I quote, "The best woofer cones are soft, pulpy and lossy. 'Piston-like motion' at, say, 100 Hz can be obtained with a woofer made of mucus; it has nothing to do with 'structual strength' but with the ratio of the cone radius to the wavelength."

Mr. Aczel, you will be happy to know that we now have, on our drawing board, a radically new woofer design. The diaphragm (which is 36" in diameter) is entirely constructed from the mucus membrane extracted from the Great American Wild Boar. Should we submit this for review?
Final Comment:

I would like to encourage all audiophiles who have read the review (sic) and who are just as outraged as we are, to write us with the intent to learn about the products we spent 50 years in designing.

I sincerely believe that the advice given by Peter Aczel and staff in The Audio Critic is an evident dis-service to consumers and has no place among other audiophile-oriented publications.

Richard Schmetterer
President
Hartley Products Corporation
Ramsey, NJ

Since Richard Schmetterer obviously fails to offer a single technical argument to repudiate our findings, and since his attempts at derision and insult are so witless as to be totally without sting, we shall leave this pathetic little tantrum unanswered except for the first paragraph. That at least makes a point, albeit a totally misleading one.

Hartley Products Corporation does indeed manufacture the 24-inch driver in the subwoofer system we tested; in fact they're selling it routinely and without any protest as a raw driver. What they don't manufacture is the enclosure in which we tested this driver. They do, however, offer a full-range "Master Reference" speaker system incorporating the same woofer in a sealed enclosure of approximately 18 cubic feet internal volume. The custom enclosure we used was also sealed, also of approximately 18 cubic feet internal volume, and fanatically well-made and braced. Therefore, what Richard Schmetterer is implying is that his 18 cubic feet of New Jersey air would have drastically lowered the Q the woofer exhibited in 18 cubic feet of New York air. If that's the case, that magic air should be bottled and sold to speaker designers in six-packs.

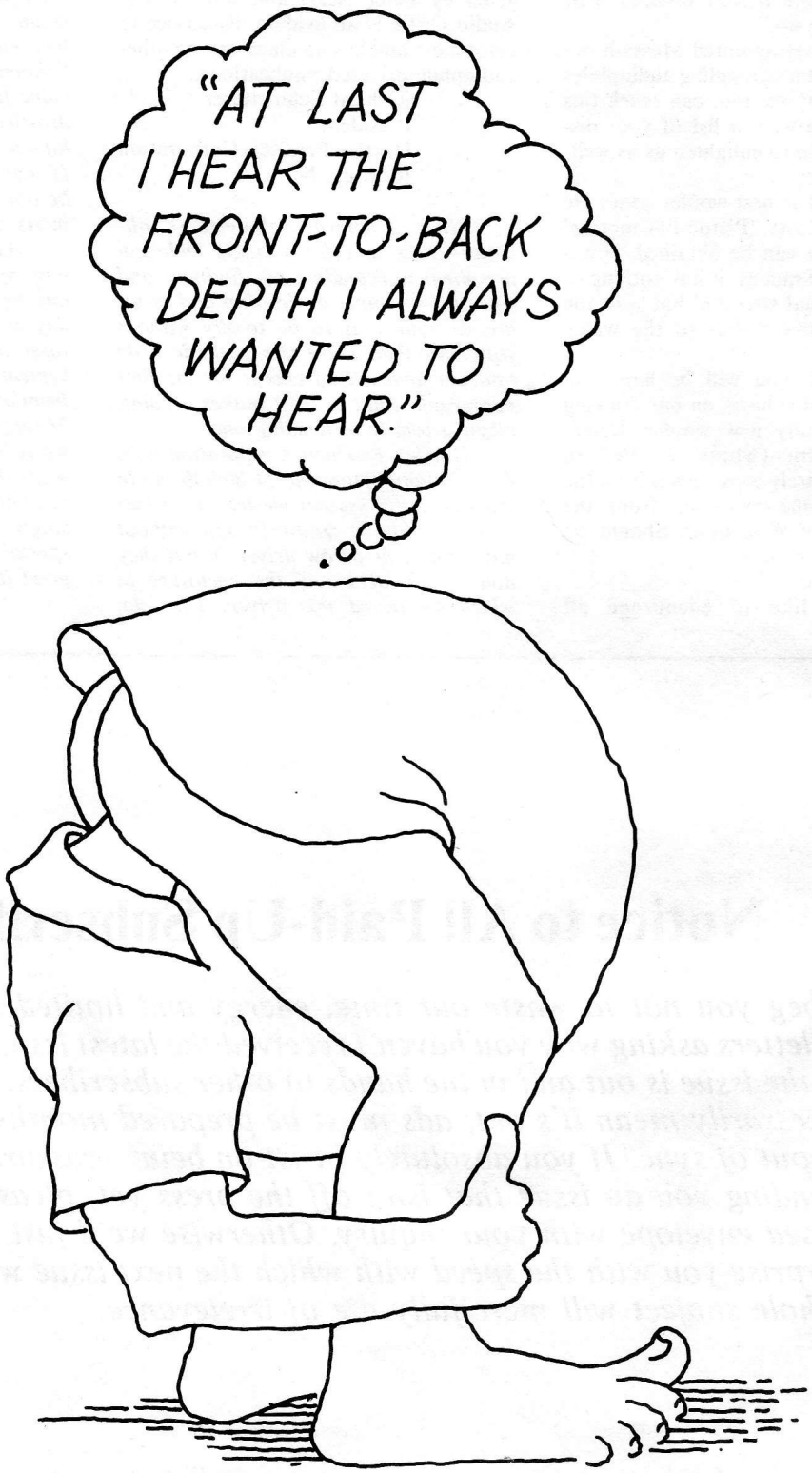
As our subscribers are well aware by now, we obtain equipment for reviewing any way we can. Borrowing it on a 90-day or 180-day memo from the manufacturer or a distributor is the most convenient; borrowing it for a few weeks from a dealer or a friend is a little less so; buying it ourselves is the last resort but we've done it. Furthermore, we document the provenance of each item at the beginning of the review. So we didn't single out Richard Schmetterer for a special handicap. He's doing a pretty good job of it on his own.

—Ed.

Notice to All Paid-Up Subscribers

We beg you not to waste our time, energy and limited secretarial budget by sending us letters asking why you haven't received the latest issue, unless you know for a fact that the issue is out and in the hands of other subscribers. Seeing an ad about it doesn't necessarily mean it's out; ads must be prepared months in advance and may be slightly out of sync. If you absolutely insist on being reassured about the impossibility of sending you an issue that isn't off the press yet, please enclose a stamped, self-addressed envelope with your inquiry. Otherwise we'll just have to ignore it. We hope to surprise you with the speed with which the next issue will follow this one, so that the whole subject will mercifully die of irrelevance.

IN YOUR EAR



CALDERHEAD

Why We're So Mean, Vindictive, Arrogant, Negative—and Truthful

By Peter Aczel
Editor and Publisher

For the orientation of our new subscribers, and as a quick refresher for our regulars, we sum up our observations, insights and reactions to date regarding the extraordinary polarization of knowledge and ignorance in the mad world of audio.

Our established format of sequentially numbered topics is continued here for indexing purposes only; there's no need to refer back to earlier editorials.

* * *

24 In the mind of the average music-loving lawyer, accountant or dry cleaner, high-fidelity sound reproduction is lumped together with other achievements of the electronic age into a single image of splendid technological sophistication. The moon landings, digital watches, satellite TV transmissions, pocket calculators, Bell Laboratories, laser microsurgery *and* stereophonic hi-fi are thought of as different manifestations of the same scientific glory. This misperception is probably the main cause of the occasional bewilderment of new subscribers upon initial exposure to **The Audio Critic.**

To understand our somewhat jaundiced view of the hi-fi industry (not to mention its press), you need to appreciate certain historical facts and unmentionable present-day truths. To begin with, audio was until *very* recently regarded by the rank and file of scientists and engineers as the shabbiest, least prestigious branch of electronics, the one to stay out of. Today's 45-year-old engineer, for example, if he graduated with honors from MIT in the mid-1950's, would have laughed in your face if you had suggested that he go to work for Fisher or McIntosh instead of taking a job in aerospace. Audio? That was for the poor slob who didn't know a Bessel function from his rear end. Especially consumer audio, i.e. hi-fi. There were, of course, a few notable exceptions; here and there a really bright and possibly even superbly trained young technologist would decide that music was important enough in his life to justify an all-out involvement in audio design; but by and large the audio companies of the fifties and sixties were under the technical leadership of engineering-school dropouts, self-taught hobbyists and other semieducated types. (One of those notable exceptions, a man who revolutionized the loudspeaker business and

then sold his company for millions, recently remarked to us: "If you want to make a lot of money, you don't go into a field that's full of brilliant people. You go into a field where there's a bunch of dummies.")

Needless to say, some of these marginal practitioners who dominated the formative years of the audio industry managed to come up with quite decent equipment, aided by good luck, good ears and completely virgin territory where anything that wasn't totally wrong was *ipso facto* right. Furthermore, just as the Dark Ages produced Charlemagne and his brilliant court, this not quite enlightened era in audio produced designers like Lincoln Walsh, Julius Futterman, Stew Hegeman, Peter Walker, Mitch Cotter, Sid Smith and other heroes in our pantheon. Even so, the prevailing engineering climate in the industry remained strictly bush-league until just a few years ago.

* * *

25 Today the situation is somewhat different. The music explosion of the latter sixties and early seventies turned the attention of many outstanding engineering students to audio, and a certain amount of synergism seems to have taken place between the best of the old-timers and the sharp new talent. The general tone has improved tremendously. At the same time, as is often the case when new knowledge and entrenched ignorance exist side by side, there's confrontation, conflict and confusion, often to the point of chaos. These are precisely the conditions that bring the muddleheaded mystics and opportunistic quacks out of the woodwork. The resulting "dynamic range" from pure bull to sheer brilliance that characterizes today's audio scene is by far the widest in history and requires special reflexes on the part of the equipment reviewer. We consider it one of the obligations of responsible audio journalism to weed out the parasites, crazies and know-nothings of the business from among the genuine contributors, otherwise the present chaos is bound to become the accepted norm and progress will be very chancy at best.

One designer of expensive audio equipment whom we respect and with whom we agree more often than not expressed to us some misgivings about the way we had punctured the hot-air balloon of one of his competitors in our pages. He felt that one high-end brand's loss of credibility, even if richly deserved, is bad for the credibility of the entire high-end business. Our reply to him was that, first of all, our job is to tell the consumer the truth whether or not it's good for business and, secondly, a man who designs $2500 speakers that sound terrible would be socially more useful if he took a job as a men's room attendant in a hotel and should therefore not be encouraged to remain a speaker designer. That just about sums up our feelings about the negative aspects of reviewing; on the positive side we feel that small but knowledgeable and conscientious makers of audio equipment need all the publicity we can give them so that they can survive in the commercial jungle. If our voice occasionally becomes a little strident or hoarse in the pursuit of these journalistic goals, at least you'll understand the intensity of the underlying convictions.

* * *

26 What are the most polarized issues in audio today? Reference criteria in listening evaluations must certainly be placed at the head of the list. Most manufacturers and most equipment reviewers form their conclusions about the sound of a component by inserting it into a third-rate system, poorly set up at that. (Example: The widely publicized "scientific" finding that all preamps that satisfy certain elementary requirements sound alike was based on listening to a cheap moving-magnet cartridge, unaligned, and AR box speakers.) Furthermore, most manufacturers and most reviewers are quite insecure in their recollection of live music. Their values derive from hi-fi, not from the concert hall. If an eight-year-old violin student who has somehow been miraculously kept away from hi-fi walked in on their listening sessions, he could instantly tell them that they're nowhere near duplicating the sound of live musicians. To our mind, an ideally authoritative statement about a listening test would go something like this: "I'm the cellist of our local amateur string quartet. I go to a concert or an opera at least once a week. I aligned this new cartridge for optimum lateral and vertical tracking geometry, and I tested it on my favorite records, first through a Beveridge system and then a Mark Levinson HQD system. Here's what I heard." As for A-B comparisons, the obvious but apparently unspeakable question, even before preference for A or B is established, is whether either A or B sounds re-

motely like music. What does it prove if garbage A sounds better than, or indistinguishable from, garbage B?

The other main cause of polarization and confrontation is our old demon, simplistic science. The mathematical models representing the hearing process and the various components of a chain of reproduction are exceedingly complex and in some cases still incomplete. Anyone, therefore, who claims that flat frequency response or vanishingly small harmonic distortion or any other one-dimensional specification is a proof of quality in audio design automatically becomes one of the bad guys in black hats in our script. On the other hand, the complexity of scientific analysis doesn't signify its futility. Since the ear itself is a measuring instrument, anything that can be heard can also be measured; the question is merely how. Just because we don't have all the answers yet, it shouldn't be concluded that totally objective equipment evaluation will forever remain an impossibility. (The golden-eared techno-illiterates sure hope so, though.) The only defensible approach is to measure everything you possibly can and then listen. Listening without the backup of laboratory data won't reveal the truth, either; not even in a purely pragmatic sense. When the typical underground reviewer tells you that the midrange is hooded and the highs are whitish, it could mean a poorly designed circuit or a defective capacitor or a low line voltage in his house or just wax in his ear. His readers will never know.

* * *

27 Speaking of polarization, confrontation and underground journals, it seems that the oldest of the latter ("Since 1962") really has it in for us. They've been irritable about our mere existence for some time now, but in their latest issue they really blow their cool and make a snarling attempt to hurt our name. Even though we never considered this haphazard little periodical to be an authority on the subject of audio (nor do any of the genuine authorities of our acquaintance), we had always considered its editor to be basically a gentleman, so we were a bit shocked as well as saddened by this incontinent baring of teeth. He must be very frustrated. (To tell the truth, we'd be frustrated, too, if we ended up where he is now after 16 years in the business, 11 of them without competition.) In any event, we've decided to put an end to the whole unpleasant affair by never again referring to him or his publication, no matter what he writes about us in the future.

* * *

And now let's turn our attention to the nuts and bolts of audio, not just the nuts.

To All Subscribers: *Consultation by telephone on individual purchasing decisions or installation problems emphatically isn't part of the services offered by* ***The Audio Critic*** *for the price of a subscription, even if you're resourceful enough to track down the Editor's home phone number.*

Sophisticated Speaker Systems, Large and Small: Our Unending Survey

By the Staff of
The Audio Critic

Part III: In which we conclude that the tweeter is half the battle, redirect our search for a reference speaker as a result, and once again identify some audiophile marvels as fugitives from the laws of nature.

Speakers continue to be our favorite subject. For one thing, they constitute the weakest link and the largest sonic variable in today's audio systems, so we can still look forward to quantum jumps in performance from time to time as new developments reach the market. Also, our best test program to date is undoubtedly the one we have evolved for speakers. We have a high level of confidence in our evaluations of amplifiers, tone arms or whatever, but we feel we're less likely to be wrong about speakers than about any other class of components. Our combination of frequency-domain, time-domain and listening tests can differentiate quite fine degrees of accuracy or inaccuracy in speaker response and zero in on design trade-off with assurance. We're frankly astonished by the chaotic disagreement among alleged experts about the performance of certain high-priced but obviously poor speakers, whereas on the subject of, say, power amplifiers we can at least appreciate the reasons for controversy even if we don't accept them. (See also our lengthy introductions to Parts I and II of this survey.)

Our basic test procedure.

We've been through this before, but for the benefit of our new subscribers and to refresh the memories of our old ones, here's a summary of what we do with each speaker that comes in for testing.

We used to start with the listening tests but we no longer do. Too many speakers have been arriving with physical defects and production errors that confuse the issue. Since we want to listen to what the engineers designed, not the goofs of Rosie the solderer or Pablo the shipping clerk, we now listen last, after getting all the laboratory tests down into our notebook.

Our procedure begins with physical inspection. We look at the quality of parts, workmanship, obvious acoustical obstructions, diffractive edges, and above all any sonic "signa-

tures" that can be elicited by lightly scratching and tapping on each cone and by whacking the enclosure with a padded stick. A lot of speakers begin to reveal their flaws right at this point.

Then come the electronic tests. First, overall frequency response (½-inch condenser microphone into spectrum analyzer), followed by nearfield response of each driver (½-inch and ¼-inch microphones, expanded sweeps). On-axis and polar response are both analyzed. Next, impedance curve and determination of woofer Q (unless readily apparent from amplitude response profile). Harmonic distortion is then measured at key frequencies (½-inch microphone into distortion analyzer). The all-important time-domain tests follow, including dynamic Q (woofer response to step function with increasing drive), tone bursts throughout the audio spectrum, and (perhaps most revealing) widely separated pulses of various durations between about 2 msec and 0.05 msec (¼-inch microphone). Before the listening tests with actual music, the sound of white noise and pink noise through the speaker is evaluated.

If any easily curable defects are discovered in the course of these tests, such as a loose component, a small air leak or a poor contact, we fix them; we don't, however, attempt to make any speaker sound better than a normal sample of it would. The speakers are then inserted into our "Reference A" system (see the article on reference systems in this issue) and auditioned with a variety of program material. We consider our favorite 30-IPS and 15-IPS tapes, played on a Studer A80 tape deck with Mark Levinson electronics, to be generally the most useful and unvarying points of sonic reference; a number of outstanding phonograph records, however, are equally revealing. If we're disgusted with the sound of a speaker, the tests don't go on very long, we must confess; the good ones are listened to for weeks on end.

We want to emphasize again, as we once explained at some length, that we don't consider these procedures to be in any way unique or original. We simply believe that they are valid and that as a result we know more about the performance of the speakers we have tested than anyone who hasn't tested them our way. There may be ways to find out even more, lots more, but not by doing *less* than what we do. And certainly not by using unaligned phono cartridges and second-rate electronics as a reference in listening evaluations.

The all-important tweeter.

Here's something we haven't discussed before. As a result of certain recent listening experiences, we're just about ready to accept as a psychoacoustic truth the claim that the ear latches on to the leading edge of a waveform, i.e. the "fastest" components of the sound pressure changes presented to it, and structures its subjective impression of the available sonic information accordingly, at least to a very large extent. It seems to be almost impossible to design a really bad-sounding speaker system as long as you put a tweeter in it that's very fast and doesn't ring appreciably in the audible range.

The tweeter that taught us that lesson most dramatically is Dick Sequerra's marvelous new Pyramid Model T-1 ribbon tweeter (see review below). But even the KEF T27, fastest of the cheap commercial tweeters, seems to be capable of turning a sow's ear into a silk purse (viz., Rogers LS3/5A, Tangent RS2, Precedent MZ Mod 3—not particularly sophisticated systems otherwise). And are you old enough to remember the Ionovac? When it worked, which was every other Tuesday, it gave even middling speakers an airy, focused you-are-thereness that was unforgettable. Don't misunderstand us; it's still possible to screw up everything with the midrange and, to a lesser extent, the bass. But the tweeter is half the battle when it comes to achieving some sort of overall subjective realism. That, at least, is the kick we're on at the present moment.

A word about "transmission lines."

As there are two systems reviewed below that utilize the principle of the acoustical labyrinth, somewhat pretentiously and erroneously called the transmission line these days, we want to restate as simply as we can our previously expressed negative views of this design approach. It isn't really wrong; it just wastes space and efficiency, and it doesn't accomplish anything that can't be done much more simply.

Here are the facts of physics. Unless you horn-load a low-frequency driver, which is a very different approach and has a different mathematical model, there are only two kinds of boxes you can put it in: (1) a box with one aperture, namely the driver cutout, and (2) a box with two apertures, the driver cutout and some kind of hole. (Several such holes are

merely a modified version of a single hole.) The transmission line is a two-aperture system just like the classic vented box; both have essentially the same mathematical model, with the exception that the transmission line introduces an extra term: a big R for that long resistive labyrinth. Those who believe in vampires, werewolves and the inherent superiority of transmission lines are therefore ascribing some sort of mystical power to that R, as if it were capable of making wonderful things happen in addition to resistive damping and a large efficiency loss. We who believe only in the laws of nature, on the other hand, contend that a properly tuned Thiele/Small vented enclosure can have, by definition, exactly the same frequency-domain and time-domain characteristics as a properly tuned transmission line, with the advantage of much smaller size for the same efficiency or much greater efficiency for the same size. In other words, the "perfect" transmission line can't possibly sound better than the "perfect" vented box, since there exists no third domain.

But wait a minute, that's not quite true. There's also the money domain, in which the transmission line is far superior. It can be sold for much more money because the consumer can easily see that it's much more complicated. The logic of numbers extends well beyond science.

On to the reviews.

The Bass Mint Model 10/24

The Bass Mint, 8300 Olentangy River Road, Worthington, OH 43085. Model 10/24 subwoofer, $475 the pair (single unit, $250). Tested #012 and #013, on loan from manufacturer.

This is, wonder of wonders, a correctly aligned Thiele/Small vented box, the first one we've tested from a commercial (albeit very tiny commercial) source. The model designation stands for a 10" woofer in a vented box tuned to 24 Hz; the alignment is fourth-order Butterworth (maximally flat); the deviations from the corresponding theoretical amplitude-response profile are minimal. We measured ±2 dB from 20 to 100 Hz, the best small-signal response in any of our woofer tests so far.

Remember, we said small-signal. The 10/24 won't give you that response at 110 dB, like a cathedral organ; its modest 10" driver is capable of only a ½-inch cone excursion and the port area is accordingly not made too large. Even so, this woofer gives you deep, deep bass at reasonably loud levels in a 26" by 21" by 19" enclosure at a very decent price—and without any major audible or measurable problems. There's nothing else remotely like it on the market until you get to the Janis kind of money, which is of a totally different category.

Not that the 10/24 is flawless, far from it. There's a bad buzz at 100 Hz, generally not activated by music but easily elicited with a 5-volt sine-wave drive, which certainly doesn't leave much margin for safety. The manufacturer claims that the buzz has been eliminated in more recent production. There's also much more harmonic distortion at 20, 40 and 80 Hz than we measured in the Janis W-1, for example. Nor is the box as rigidly braced as we'd like; we discern a smidgen of musical coloration of the same quality as the sound of the side panels when thumped, which is a pity since the cone itself is impressively dead. The manufacturer claims that the bracing is also improved in the latest units. Even so, everything considered, this is the best inexpensive subwoofer known to us. The designer obviously did his homework.

Canton Gamma 800L

Adcom, 11A Jules Lane, New Brunswick, NJ 08901. Canton Gamma 800L compact speaker system, $598 the pair. Five-year warranty; manufacturer pays return freight. Tested #008249 and #008283, on loan from distributor.

This expensive 11-inch black cube, incorporating a three-way system, is the top-of-the-line minispeaker from Canton (Germany, not China) and is quite typical of the breed. That means it's bumped up in the bass (100 Hz peak, Q = 1.75) and then begins to flatten out; from 1 kHz to 20 kHz it's frighteningly flat (±2 dB); at 20 kHz it's up 2 dB and then drops like a stone; and, of course, it's totally incoherent in the time domain, the three drivers being strictly amplitude matched.

The resulting sound is whompy in the bass and has no focus at all, just as you'd expect. What you wouldn't expect is a red-hot top end, glary and spitty at the same time. Transient attacks are poorly reproduced. It's a gorgeous little speaker to look at, though; too bad we don't listen with our eyes.

Cizek MG-27

Cizek Audio Systems, Inc., 15 Stevens Street, Andover, MA 01810. Model MG-27 subwoofer, $590 the pair (single unit, $295). Five-year warranty; manufacturer pays all freight. Tested prototypes and early production samples, on loan from manufacturer.

We had high hopes for this subwoofer, which have not been fulfilled so far, although they may conceivably be if the unit is successfully debugged in later production. Our hopes were based on the design concept of the MG-27, which is simple, pure and correct. Two long-throw 10" woofers are completely enclosed to yield second-order Butterworth response (maximally flat, Q = 0.707), with the system resonance, and therefore the -3 dB point, at 27 Hz. This is *the* perfect alternative to the vented approach exemplified by The Bass Mint Model 10/24 reviewed above; it gives up a few cycles on the bottom by comparison (the box is somewhat smaller to begin with) but should have slightly better damping characteristics.

Unfortunately, the prototypes as well as the early production samples we looked at were full of buzzes, air leaks, impedance ripples, and all sorts of glitches in the response profile, making their potential sonic capability almost impossible to evaluate. There was really no frequency below 100 Hz where they didn't buzz at least a little bit. Some of this is probably curable; however, we also suspect circumferential resonant modes caused by the mass-loading of the driver cones at the apex, which is a basic design problem.

Another peculiarity of the MG-27 is that, when a supposedly matching Cizek Model #2 speaker system is "correctly" connected to its built-in passive crossover, the two systems are amplitude matched but out of phase. When you put them back in phase by "incorrectly" reversing the leads (red to black, black to red), there's a 10 dB suckout but more transparent sound. We don't believe in phase reversal as an amplitude matching technique.

We want to reserve final judgment on this basically honest and intelligently conceived product until Cizek gets the whole act together.

Fried Model B/2

Fried Products Co., 7616 City Line Avenue, Philadelphia, PA 19151. Model B/2 Mini Monitor, $500 the pair. "Indefinite" warranty, at discretion of manufacturer. Tested #XB005 and #XB006, on loan from manufacturer.

This is a Rogers-size minispeaker, with a mild cultist aura that emanates chiefly from the manufacturer, and various little mods and retrofitting recommendations announced at frequent intervals to keep the faithful hopping. It can be used either separately or as a "satellite" of the Fried Model T subwoofer (see review below). Actually, it's a good little speaker, comparable to other good little speakers (Rogers LS3/5A, Tangent RS2, Symdex Sigma), all of which opt for different design trade-offs and performance compromises.

The B/2 gives up some speed and, especially, dispersion in the tweeter (see also our tweeter discussion above, before the reviews) by using a relatively large one to gain power handling and dynamic range. The 5" midrange/woofer cone also handles power surprisingly well. The overall sound of the speaker is quite uncolored, free from stress and well-defined, lacking only the ultimate detail and airiness possible with a different approach to tweeter selection. That, however, is an important reservation.

The axial response of the system is within $\pm$3 dB from 70 Hz to 22 kHz, except for a peak of 4 dB at about 1.1 kHz, where we also observed some severe ringing on tone bursts; the tweeter is flat only to 15 kHz at 20° off axis and keeps rolling off as the angle increases; furthermore the tweeter produces an extra cycle on tone bursts throughout its range and looks a bit slow on the first cycle. It all figures. Pulse replication is basically good, though, to 0.1 msec and even a little beyond. As for the Q of the midrange/woofer in its box, it's very close to the ideal 0.707 and stays there even with increasing drive.

All in all, as you can see, we have no major

complaints about the B/2 but we can't get terribly excited about it, either. It doesn't seem to have any crippling defects but at the same time lacks the breath of life possessed by other two-way dynamic speakers designed with different priorities, such as the Tangent RS2 and the DCM Time Window.

Fried Model T

Fried Products Co., 7616 City Line Avenue, Philadelphia, PA 19151. Model T two-channel transmission-line subwoofer, $1400. "Indefinite" warranty, at discretion of manufacturer. Tested #T10113, on loan from manufacturer.

You can look at this double transmission-line subwoofer two ways. You could say that it contains two very decent 10" woofers in properly damped enclosures, one for each channel of your stereo system (less than 4 feet apart, to be sure), with reasonably flat frequency response down to the -3 dB corner of 35 Hz. Or you could say that it's the most insane cult item in all audiodom, since a pair of Cizek 10" bookshelf systems will give you just about the same response profile and comparable damping characteristics for $396 instead of $1400, with tweeters thrown in; and for $475 a pair of Bass Mint 10/24's will go down almost an extra octave below the Model T.

Please go back to our remarks about transmission lines in the introduction to this article. This is a classic case; the Model T occupies approximately 12 cubic feet of space, weighs 175 pounds, costs more than any other pair of woofers we can remember offhand—and it's nothing more than a good, clean 35-Hz box. Please don't ever say that we knocked the performance; the Model T sounds good. Just like other good, clean 35-Hz boxes.

Well, as a matter of fact, we found something that wasn't so clean: when pulsed, the unit produced a spurious second blip 25 msec behind the first pulse, through the transmission line. This was just audible as a slight thickening of the sonic texture; however, the manufacturer informs us that a new mod eliminates this condition (in fact, they offered to fix it in our sample, but our tests were over by then), so we don't want to make a federal case of it.

A pair of Model B/2's connected to the slow-slope passive crossover available on the back panel of the Model T add up to the Fried Model H/2 System. How does it sound? Not quite as focused in detail at a pair of B/2's alone, although the bass is extended by an octave. We're giving it the benefit of the doubt, though, in view of the mod that eliminates that 25 msec delay.

Janis W-1
(follow-up)

Janis Audio Associates, Inc., 2889 Roebling Avenue, Bronx, NY 10461. Model W-1 Subwoofer System, $1350 the pair (single unit, $675). Tested #141588 and #141589. Interphase 1 Electronic Crossover/Bass Amplifier, $990 the pair (single unit, $495). Tested #10122 and #10123. All samples on loan from manufacturer.

Here's a rather special case requiring an upward revision of a previous evaluation. We now consider the Janis W-1 to be the best subwoofer on the market, regardless of price. In our original test (see Vol. 1, No. 2, pp. 32-34), we found the W-1 to be almost dead flat from 100 Hz on down to 30 Hz (-3 dB at 26 Hz) and incredibly low in THD, but it seemed to make everything sound thick, opaque and unfocused, even though the electronic crossover was correctly set for a perfect amplitude match to the rest of the system at 100 Hz. We suspected some out-of-band peaks, particularly one at 460 Hz (i.e, more than two octaves above the crossover), to be the culprit, especially since such peaks are a necessary concomitant to the unique slot loading used by Janis.

Well, what has changed? It would be an easy out for us to report merely that a minor internal modification has changed that 14 dB peak at 460 Hz (without crossover) to an 8 dB peak at 420 Hz, and that through the 18-dB-per-octave crossover the whole thing is now below some kind of audible threshold that was exceeded in the original version. That may be part of the reason but it isn't the whole story. The fact is that the Janis W-1 energizes the whole room in the bottom octave of the audio range like no other woofer, and our reference turntable at the time (Luxman PD-121) was much too active acoustically in that kind of sound field. Unfortunately, this happened when we hadn't quite phased in our master-tape listening tests yet. Another difference is that the Janis has now become a bass *system*,

instead of just a subwoofer, through the availability of the matching Interphase 1 bass amplifier, which has carefully tailored complementary electrical characteristics plus a built-in electronic crossover with straight-wire bypass switching capability (woofer in vs. main system alone). The latter feature convinced us that the electronic stages of the crossover are inaudible.

We haven't formally bench-tested the Interphase 1 yet but can report that it works beautifully with the W-1. As for the subwoofer itself, a pair inserted into our reference system is currently giving us the best bass of our lifetime, rock solid, wide open right down to the bottom limits of the program material, and with that realistically breathy quality that only the accurate reproduction of the lowest frequencies can bring out.

Mind you, we don't consider the Janis to be the theoretically perfect woofer. It's basically a high-efficiency narrow-band resonator (its mathematical model actually has two apertures in *series*) that barely gets away with cheating Mother Nature by stonewalling its very restricted linear range with steep crossover slopes. (We're told that a 36-dB-per-octave Janis crossover is coming soon, indicating that John Marovskis himself sees the problem that way.) Nor can the W-1 produce 125 dB at 20 Hz, which is what you get in real life under extreme conditions. But, then, why should the woofer be more perfect than the rest of the system? The Janis may be a somewhat questionable electroacoustic sleight of hand, but at least it works—right here and right now.

Magneplanar Tympani I-D

Magnepan, Inc., 1645 Ninth Street, White Bear Lake, MN 55110. Magneplanar Tympani I-D speaker system, $1395 the pair. Tested #044646, on loan from dealer.

We haven't been able to figure out so far why this speaker has a fanatical cult following. That usually happens only to exquisitely good or perversely bad products, and the "Maggie" is neither. It's merely a valiant but not quite successful attempt to fool Mother Nature.

As you probably know, the Tympani I-D consists of a pair of triple screens or room dividers, the entire surface of which is active, front and back. It's a true dipole speaker, with all the advantages and disadvantages of the breed. It also tries to be a force-over-area transducer but doesn't quite make it. That grid of wires acting as a distributed voice coil doesn't have total control of the diaphragm in the same sense as the electrostatic field controls every square millimeter of the membrane in an electrostatic system. A number of problems arise as a result.

Typical dipole response is characterized by a 6-dB-per-octave falloff below a certain frequency, as an inevitable consequence of back-to-front phase cancellation. The Magneplanar design tries to cheat this law of nature by amplitude matching the bass panels to the midrange. The resulting power response into the room, copied by our measuring microphone edgewise to read the sum of both dipole lobes, is indeed flat down to 40 Hz, with the half-power (-3 dB) point at 36 Hz. The monopole characteristic, on the other hand, is bumped up approximately +6 dB at 40 Hz, with heavy consequences in the time domain. The response to a step function indicates a dynamic Q in excess of 2, which isn't exactly tight bass, and that figure appears to rise with increasing drive. You can't eat your damping and have it too.

The midrange of the Tympani I-D is generally quite smooth; the highs are rougher, with a vicious peak at 14 kHz, where we also observed some severe ringing. The tone burst tests showed at least two extra cycles produced by the speaker at all frequencies, and more where there was actual ringing (e.g., at 14 kHz). This is very poor performance and indicates serious energy storage problems in those large panels. There's obviously no force-over-area control. The pulse tests turned out to be the most interesting, as they revealed the entire character of the speaker. The pulse shapes looked excellent at all widths down to 0.15 msec, but each pulse was followed by a long trail of overhang ripples. In other words, the fast part of the signal was accurately reproduced, but spurious energy came out of the speaker for a much longer time.

And that's exactly what the Maggie sounds like. Its sonic signature is "snap-blur." Clean attack, followed by a wash of vagueness. Those

who say it has excellent transient response are right, in a sense; those who feel it's unclear are also right; those who insist it's one of the world's great speakers don't know what they're talking about. For example, a 30-IPS master tape of a solo acoustic guitar played through the Magneplanar had a peculiarly smeared, hollow sound until we switched to a pair of Tangent RS2's. Instantly, the guitar became a focused presence in a three-dimensional space. It was almost embarrassing, with the 3-to-1 price ratio of the two speakers and not even a decent measure of doubt as to which was more accurate.

Despite all this, we don't find the sound of the Magneplanar Tympani I-D unmusical; it's quite pleasant and listenable. But a reference speaker it isn't and will never be.

Precedent MZ Mod 3

Precedent Audio Products, Inc., 306 East Oliver Street, Baltimore, MD 21202. MZ Modular 3 speaker system, $1333 the pair. Three-year warranty. Tested samples on loan from manufacturer.

In a world of good, bad and mediocre speakers, this would have to be classified as a good speaker, but that doesn't mean we admire the design or are wild about the sound.

The best part of the MZ Mod 3 is the KEF T27 tweeter, which goes out smoothly to 35 kHz (yes, thirty-five) and hardly rings at all at any frequency. If you've read our comments about the importance of tweeters in the introduction to these reviews, you know what that means. There can be no doubt that the MZ Mod 3 sounds open, airy and "present." Since all three drivers (all KEF, by the way) are enclosed in separate modules, we can then move down to the next best part, the woofer. This is a transmission line and, to refer you back again to the introduction where we discuss transmission lines in more detail, that means it comes out in exactly, but exactly, the same place where a smaller and cheaper Thiele/Small vented box would have, using the same driver. But at least it's decently executed, so the response is flat and smooth down to about 40 Hz, below which it drops rapidly; the damping appears to be correct and tone bursts elicit no misbehavior. So right away you can surmise that the MZ Mod 3 has a solid, well-controlled, clearly defined bass, and you're right. But that's an expensive 40-Hz box, fella.

Now comes the not-so-good part, the midrange module. This is also sold separately, in conjunction with the tweeter, as a complete small system at half the price. It goes down surprisingly low (as a separate system) and is also a transmission line, but a lot messier than the bass module. On tone bursts, it gives you five cycles for the price of four anywhere above 400 Hz and also dumps all kinds of additional garbage between 1 kHz and 5 kHz, including ringing, cancellations, envelope variations, you name it. The crossover network that puts all this together is even messier, synthesizing anomalies that would take a whole treatise to analyze, and it drives the tweeter out of phase with the midrange and woofer, so that the system produces only a kind of "facsimile" pulse but no genuinely coherent wave front. The KEF tweeter is able to define the beginning and end of a pulse, and the midrange and woofer fill them in after a fashion, but true coherence it ain't.

The faulty midrange cramps the style of the tweeter and the woofer, so that the total sound is a bit glary and hollow, with a sense of strain. What could have been a really fine, though needlessly eccentric, speaker ends up as, eh, pretty good. And not cheap.

Pyramid Model T-1

Pyramid Loudspeaker Corporation, 131-15 Fowler Avenue, Flushing, NY 11355. Model T-1 Ribbon Tweeter, $990 the pair. Three-year warranty. Tested #0163 and #0164, owned by The Audio Critic.

This is without doubt the most exciting product reviewed in this issue. It has changed our audio life. What more can we say? We're not even sure whether Dick Sequerra fully realizes how good his new ribbon tweeter is; at one time he was equally messianic on the subject of the Metronome speaker.

A limp ribbon in a strong magnetic field is the theoretically perfect force-over-area transducer; how we wish somebody made one as tall as the Beveridge speaker. (Many years ago, we're told, a bunch of audio-freak scientists at the University of Chicago stretched a large sheet of Reynolds Wrap in the gap of the cyclotron and fed some music into it. They've

never been satisfied by any speaker since. When we told this story to Mark Levinson, he seemed very interested and started calling his production people.) The trouble is that the right magnet is terribly expensive and so is a really good transformer, the latter being absolutely necessary for the impedance match between the virtually zero-impedance ribbon and the power amplifier. The Decca ribbon tweeter, for example, which costs less than the Pyramid, has a rather skimpy transformer that rings quite badly, even though the transducer itself is very accurate. (We found that out in an impromptu test of a borrowed unit.) We have a pretty good idea what the cost of the parts is in the T-1, and, believe it or not, it isn't a high-profit item even at its exorbitant price.

So here's what Dick Sequerra did. He put a large ribbon (larger than the Decca or the old Kelly) into an extremely powerful magnetic gap to achieve the highest possible efficiency. He made a matching transformer for it that goes down to 100 Hz, even though the tweeter is used only above 3 kHz. He designed a 5-position filter/attenuator for level matching as well as crossover. And he put the whole thing together in a slightly pyramidal (aha) black metal case. The result is the best tweeter in the world, at least the world we're familiar with.

First of all, the frequency response is almost as smooth as that of an amplifier. None of the usual jagged speaker profile. There's a slight downward slope, absolutely straight, which may be due to mass or is possibly a characteristic of the filter/attenuator. (The latter varies the response profile slightly at different settings, a feature we didn't like at all; a more sophisticated network may be necessary.) This gentle, linear slope continues almost indefinitely into the ultrasonic region. In other words, the tweeter isn't absolutely flat but is extremely wideband, fast and smooth. Its rise time is hard to measure because it approaches that of the measuring microphone itself. Some early samples we looked at showed quite a bit of ringing on tone bursts at a few discrete frequencies, but the units we finally put into our reference system have greatly improved mode suppression and don't ring appreciably. The white-noise and pink-noise sound of the tweeter is considerably less grainy than that of conventional cone and dome units. Best of all, the T-1 can handle almost unlimited power; it will self-destruct before it overloads acoustically.

Needless to say, we aren't calling this the world's best tweeter because of its performance on the lab bench. It's what it did when connected to various speakers that sold us. The first speaker we tried it with was the Tangent RS2 and immediately we heard a clarity, openness, definition and headroom that in some ways made the combination already preferable to the Beveridge. (Not in the midrange, of course.) Further experiments with other dynamic speakers indicated that the tweeter could make almost any half-decent system into a virtual SOTA contender, at least in some respects. That's how we arrived at our conclusion about the decisive role of tweeters as discussed in the introduction to these reviews (see above). When we finally mated the T-1 to a suitable electrostatic midrange, we had a Beveridge beater for sure (see the article on reference systems elsewhere in this issue). The last little fillip was added when we connected the T-1 to the latest modification of the Futterman amplifier. We can honestly say we've never heard a cleaner, smoother, more detailed top end than that, ever. Now we can't stand listening to anything else.

Maybe that much abused word "breakthrough" is for once appropriate. At last we have a reference standard, meaning something so accurate and clean that it instantly shows up anything plugged into it that's less accurate and clean. It makes us sad to ponder, though, that various influential audio people who don't have their act together, who ignore the whole question of phono catridge alignment and use moving-magnet cartridges, acoustically active turntables, unstable amplifiers, etc., will try the Pyramid T-1 and find it to be just another tweeter. On the other hand, Dick Sequerra can't make all that many of them, anyway, so it's probably just as well that not everyone will share our enthusiasm.

Symdex 'Sigma'

Symdex Corporation, PO Box 927, Framingham, MA 01701. 'Sigma' loudspeaker, $598 the pair. Tested #091507 and #091508 (also auditioned #101601 and #101602), on loan from manufacturer.

The officially avowed intention of this small new firm with their first product, the

Sigma two-way speaker system, is to exceed in accuracy all previous dynamic loudspeakers from 60 Hz to the limits of audibility, with an optional woofer to be brought out later for extending the range downward. They claim to have looked into and optimized everything: "time delay distortion, frequency response, diffraction, system Q, and early reflections," according to their literature. If that's true, the Sigma ought to clobber all the other expensive small speakers, including the Rogers LS3/5A, Tangent RS2, Fried Model B/2—anything with a small woofer and tweeter. And in some ways it does, but there are trade-offs, as usual.

With the measuring microphone at the "sweet spot," the Symdex speaker has impressively flat frequency response, from the -3 dB corner at 60 Hz right on up to the ultrasonic region, and possibly the best pulse response we've ever measured, not even excepting the Beveridge. When the mike is moved, however, the pulse response deteriorates; the cone of coherence is quite small, so Harold Beveridge can relax. Exploring the nearfield at points other than the sweet spot also reveals a slight but unmistakable saddle in the frequency response, with the dip at 1 kHz. Tone bursts are excellent throughout. Overall, this is still quite brilliant test bench performance.

There were two little things we found, however, that we didn't like. One was that the system Q, which is in the desirable 0.7 to 0.9 ball park on small-signal analysis, migrates to approximately 1.3 at high drive levels. The voice coil obviously comes out of the gap. The other peculiarity was that the small Audax soft-dome tweeter (one of the really good ones in the business, dead flat to 20 kHz and good to 33 kHz, rivaling the KEF T27) appeared to be receiving full power down to 800 Hz, although the nominal crossover frequency of the first-order dividing network is several octaves higher than that. This is bound to overload the tweeter from time to time and dump sidebands all over the spectrum.

Both of these problems are made more serious by the fact that the speaker is extremely inefficient, so that it's quite likely to be driven hard enough to activate both distortion mechanisms.

In our listening tests the Symdex appeared to have the least coloration (most neutral sound) among our favorite dynamic speakers, as well as the best balance and most distinctly focused image. We didn't, however, like its dynamic behavior. It didn't seem to "breathe" with the ebb and flow of the music and appeared to have a slightly strangled quality on dynamically varied program material. This was alleviated to some extent by crossing it over to the Janis woofer at 100 Hz, but not entirely. The two faults we had found in the lab may have been the reason.

Overall, we don't quite know where to rank the Symdex Sigma. In some ways it's better than either the DCM Time Window or the Tangent RS2, our two favorite time-coherent dynamic speakers so far; in some ways it isn't. The Time Window, especially, is more satisfying musically with its better headroom, even though it's obviously more colored in the purely objective sense. Our feeling is that the Symdex is the product of a single-minded, one-dimensional perfectionism, in a restricted design format that yields perhaps more readily to the seasoned compromiser. Still, it's an auspicious start for what looks to us like a very serious young company.

Thiel Model 03

(interim report)

Thiel Audio Products Company, 4158 Georgetown Road, Lexington, KY 40505. Model 03 floor-standing coherent-source loudspeaker, $775 the pair. Tested #0009 and #0010, on loan from manufacturer.

This was planned to be a full-fledged review but has turned into an interim report because the early samples that were rushed to us are no longer representative of the product. The all-important midrange has apparently been totally revised. We're waiting for new samples.

Meanwhile we merely wish to point out that this very handsome unit is directly competitive with the DCM Time Window in size and audiophile appeal; it will have to outperform the latter in order to justify the $115 difference in price, though. In one respect it definitely outperforms the Time Window; the electronically equalized sixth-order Butterworth response of the vented bass enclosure is dead flat down to 28 Hz and -3 dB at 25 Hz. That's the small-signal response, of course; from 50 Hz on down to 20 Hz you can't drive the woofer very hard without creating a great rushing noise through the vent. This part of our

measurements is unlikely to change with the new samples.

Also like the Time Window, the Model 03 is carefully aligned for time coherence; the pulse response looked excellent. But we have no idea what the final production units will sound like.

Watson Laboratories Model 10-H

Watson Laboratories, 2711 Rena Road, Mississauga, Ont. Canada L4T 3K1. Model 10-H speaker system, $1950 the pair. Tested #417L and #418R, on loan from manufacturer.

Mike Wright, the original founder of Dayton Wright and inventor of the XG-8 electrostatic, attracts a cult following no matter what he does and where he goes; his new line of dynamic speakers under his new brand name (he sold Dayton Wright to Leigh Systems) has consequently been spoken of in hushed tones in some circles, but we ended up being very disappointed with the top-of-the-line Model 10-H. We don't feel any desire to do a number on it driver by driver (there are two in the woofer and seven in the top section, per side!); luckily we have a perfect out because the units we tested had been manufactured in March or April, 1978, and just barely missed getting into our last issue, so there's a strong possibility that current production models are better. Mike Wright isn't the kind of engineer who leaves bad enough alone.

Basically the problem we found was that this is a strictly frequency-domain oriented design, with no attempt at coherent geometry, no recognition of the dangers of energy storage, no control of system Q, no attention to the time domain at all. The speaker did very poorly on every one of our tests (as listed in the introduction to these reviews), with the exception of frequency response, which was decently flat from 28 Hz to beyond 20 kHz—but only at the "sweet spot." With the multitude of drivers pointing every which way (a design approach we could never relate to), it was difficult to get even that result. The gas-filled woofer enclosure (a Wright hallmark) had its own special, and especially horrendous, resonances; nothing really worked perfectly on our samples.

The resulting sound was blurred, diffuse and very indistinct, creating the impression of a totally noncoherent field. The poor definition was aggravated by a wiry quality on top; a tubby, poorly controlled quality in the bass; and a nasal, hollow, boxy quality overall. We sure hate to end our reviews on this note, but we tested no speakers beginning with X, Y or Z.

Recommendations

As our reference system gets better and better, we're becoming less and less tolerant of the shortcomings of even the best small speakers (Rogers, Tangent, Fried, Symdex, etc.). We're therefore dropping that category from our Recommendations, even though the speakers sound just as good as they ever did. Read the reviews and suit yourself.

Best speaker system: Reference A of *The Audio Critic* (see article on reference systems).

Best speaker system from a single manufacturer: Beveridge System 2SW-1.

Best speaker system per dollar: DCM Time Window.

* * *

Best tweeter: Pyramid Model T-1.

Best subwoofer: Janis Model W-1 with Interphase 1.

Best subwoofer per dollar: The Bass Mint Model 10/24.

Speaker Summaries and Updates

These reviews appeared in Volume 1, Numbers 1, 2, 4 and 5.

Acoustat X

Acoustat Corporation, 4020 North 29th Avenue, Hollywood, FL 33020. Acoustat X full-range direct-drive electrostatic speaker system, $2200 the pair (with built-in power amplifiers).

A crossoverless full-range electrostatic speaker driven directly off the plates of its matching amplifier's output tubes—what could be a purer concept? Unfortunately, the design is badly flawed, with obvious standing waves in the panels, bad ringing at quite a number of frequencies, and no coherence on pulse reproduction. There are also bad lobes in the polar response and horrible overload in the 35 Hz region. As a result, the speaker is incapable of sounding as smooth, effortless and focused as a sophisticated electrostatic is expected to. The newer Acoustat Monitor ($3000 the pair) is an expanded version of the same basic system.

Beveridge System 2SW-1

Harold Beveridge Inc., 505 East Montecito Street, PO Box 40256, Santa Barbara, CA 93103. Beveridge Cylindrical Sound System, Model 2SW-1, $7000 the pair (including plug-in direct-drive tube amplifiers, HD subwoofers, solid-state bass amplifiers, electronic crossovers and CM-1 control module).

This is the latest version of a marvelous electrostatic; what we tested (System 2SW, $6000 at the time) was identical from 100 Hz up, so there can be no great surprises. The 2SW-1 modification includes slightly revised woofers (Q = 0.707 is claimed), with matching bass amplifiers, plus a new electronic crossover. Our judgment is that it can only sound better, certainly not worse, than the 2SW, which was the best speaker system we had tested before assembling our own Reference A. We still consider the coherent cylindrical sound field of the Beveridge to be superior to the radiation geometry obtainable with Reference A, and we don't know of a more transparent midrange than that of the Beveridge, either. Compared to the Pyramid Model T-1 tweeter, however, the Beveridge has somewhat rolled-off highs; the bottommost bottom just isn't like that of the Janis; and the dynamic headroom of the system is quite inadequate by ultimate standards. Still, for many people, this will remain the ultimate system because of the way it "illuminates" the room with sound.

Braun 'Output C' and L200

Adcom, 11A Jules Lane, New Brunswick, NJ 08901. Braun 'Output C' miniature speaker system, $230 the pair. Braun 1,200 small bookshelf speaker system, $270 the pair.

Just about the smallest high-fidelity speaker in the world (Output C) and its very similar "big" brother (about twice as large but still smaller than the Rogers)—are you interested? They're a bit bumped up at the system resonance to fake the bass, and their tweeters ring quite a bit, but the sound is amazingly listenable, maybe a little on the zippy side. Not for the purist, though.

Canton HC 100 and LE 400

Adcom, 11A Jules Lane, New Brunswick, NJ 08901. Canton HC 100 miniature speaker system, $190 the pair. Canton LE 400 bookshelf speaker system, $350 the pair when tested (no longer listed under this model designation).

Also from Germay, like the two Brauns above, and comparable. The HC 100 is teeny-weeny like the smaller Braun and similarly bumped up on the low end; its tweeter is cleaner, though. The LE 400 is about half a cubic foot in volume and has better bass, as well as an astonishingly flat, fast tweeter that almost fools you with its openness and presence, until the lower-treble ringing gets to you and you realize that the system is quite fatiguingly overbright and "electronic". Neither Canton has even nodding acquaintance with time alignment, so the inner detail is quite unfocused as a result.

Cizek Model #1 and Model #2

Cizek Audio Systems, Inc., 15 Stevens Street, Andover, MA 01810. Model #1 and Model #2 acoustic-suspension loudspeakers, $396 and $268 the pair, respectively.

These are virtually identical two-way systems, #1 with a 10" and #2 with an 8" woofer. In contrast to the Rogers-type minimonitors with their tiny midrange/bass drivers crossed over at a high frequency, the Cizeks give you solid, correctly damped bass down to 38 Hz and a 1.5 kHz crossover that puts much more of a power demand on the tweeter. The resulting design trade-offs end up as somewhat zingy and edgy sound, not nearly as refined as that of the minimonitors. On the other hand, it's still a very decent sound for this kind of money.

Dahlquist DQ-10, DQ-1W, DQ-LP1

Dahlquist, Inc., 27 Hanse Avenue, Freeport, NY 11520. Phased Array Model DQ-10, $850 the pair. DQ-1W Low Bass Module, $550 the pair (single unit, $275). DQ-LP1 Variable Low-Pass Filter, $250.

The DQ-10 was the first truly sophisticated dynamic speaker system of the mid-1970's; it still stands up quite well but has since been bested in clarity and listenability by a number of cheaper speakers. Its "clubfoot" is the Motorola piezoelectric horn tweeter, which is totally incapable of passing recognizable pulse-type waveforms. The DQ-1W is a well-designed sealed-box woofer; however, its -3 dB point is at 42 Hz, and that's not good enough to give you the bottommost notes of the organ and such. The DQ-LP1 is a combination active low-pass and passive high-pass filter for biamping; it can't possibly add distortion on top and does its job very nicely on the bottom, with variable crossover frequencies. Highly recommended for the money.

Dayton Wright XG-8 Mk 3 Series 3

Dayton Wright Associates Limited, 350 Weber Street North, Waterloo, Ont., Canada N2J 4E3. XG-8 Mk 3 Series 3 full-range electrostatic loudspeaker, $3295 the pair.

One of the biggest cult items in the history of high-end audio, this electrostatic is a real turkey in our book. Peaky,

with severe ringing at numerous frequencies, it sounds honky and unclear in the midrange, hard and zingy on top. It's possible that much earlier versions sounded better; stay away from this model, in any event.

DCM Time Window

DCM Corporation, 2275 South State Road, Ann Arbor, MI 48104. Time Window floor-standing loudspeaker, $660 the pair.

Since we last wrote about the Time Window, minor modifications have again taken place. We rechecked the latest units. The capacitors in the crossover network are now Mylar; the bass has been flattened out slightly and extended *very* slightly (the -3 dB corner is now at 48 Hz); the tweeter peak has been reduced but it's still there (this time at 13 kHz, still ringing); the tweeter response now goes out flat to 15 kHz and is down "only" 10 dB at 20 kHz. The excellent pulse response has been retained but the tweeter is still out of phase. The net result of these small improvements is to confirm our ranking of the Time Window as the relatively best choice among all the highly imperfect speakers in this price range. Yes, it has a slightly hollow quality in the upper bass and lower midrange; it doesn't even give a tremendous sense of immediacy; but its openness, balance, excellent dispersion and remarkable headroom (for this type of speaker) give it the breath of life when it plays music.

Fundamental Research

Fundamental Research, 1304 Success Street, Pittsburgh, PA 15212. 'The Low Frequencies' subwoofer, $900 the pair (single unit, $450).

When we tested the original Fundamental Research subwoofer, we couldn't find much wrong with it except that it was overdamped, so that it didn't take full advantage of its fairly large dimensions to go down flat as low as possible. The revised version, which we have more recently tested, is still overdamped (Q = 0.58, 0 dB at 60 Hz, -3 dB at 40 Hz, -9 dB at 20 Hz); we don't believe that the slight time-response advantage with such a very low Q is audible, whereas the loss of amplitude response is. What's more, the subwoofer now has two 10" drivers in parallel, instead of the previous single 12", with the result that the impedance is down to 3 ohms across a fairly wide band of frequencies. We don't think that's quite right; it can blow out amplifiers that way. Apart from that trifle, we still like everything; the Q is retained at all available drive levels, tone bursts look good, the sound is very clean and tight—but the bottom of the bottom end isn't there.

Hartley 24" Subwoofer

Hartley Products Corporation, 620 Island Road, Ramsey, NJ 07446. 24-inch Woofer-Driver, $375 each (without enclosure).

This is an irrational design: a 24" woofer with a puny 1½" voice coil pushing its 21½" cone and with a free-air Q of approximately 0.7, so that it can't possibly be enclosed in a sealed enclosure of less than 50 cubic feet or so without making it woof up and whomp and ring. In a mere 18 cubic feet, the Q is 2 and the bass hump +6 dB at 48 Hz. The cone has an aluminum tube sticking out from the middle, purportedly a heat sink for the voice coil, but actually a peaky "supertweeter" that goes out to 29 kHz! The fact that the Hartley can grab a lot of air in the midbass and make it move is its only redeeming feature, but who specified these ridiculous parameters and what were his reasons?

Infinity QLS

Infinity Systems, Inc., 7930 Deering Avenue, Canoga Park, CA 91304. Quantum Line Source speaker system, $2500 the pair.

With 17 drivers per side and totally bollixed-up radiation geometry (the "line source" appellation is a joke), there just can't be any real focus, inner detail and stable imaging—and there isn't. The 'EMIT' tweeters, by themselves, are quite excellent but very inefficient; the midrange domes are peaky; the 5" midbass driver rings like a telephone; and the 12" Watkins woofer can't take the biggest bass wallops. The overall sonic results are on the decent side of mediocre, that's all; this is no reference speaker. And that makes us wonder about the new Infinity QRS at $6500—do these people really listen?

Innotech D24

Innotech, 42 Tiffany Place, Brooklyn, NY 11231. Model D24 floor-standing speaker system, $854 the pair.

The tweeter is good; the midrange dome rings severely throughout its range; the woofer is a somewhat bumpy 50-Hz box. Highly colored sound with a distinctly "canned" quality.

Janis W-2

Janis Audio Associates, Inc., 2889 Roebling Avenue, Bronx, NY 10461. Model W-2 Subwoofer System, $900 the pair (single unit, $450).

The W-2 is virtually identical to the W-1 (see Janis follow-up review above) with the exception of the last few Hz on the bottom, where the W-1 stays flat and the W-2 starts rolling off. Thus, our favorably revised evaluation of the Janis bass system is likely to be equally applicable here, although we haven't retested the W-2.

Koss Model One/A

Koss Corporation, 4129 North Port Washington Avenue, Milwaukee, WI 53212. Model One/A full-range electrostatic speaker, $3000 the pair.

So far, nobody but Koss seems to be able to make electrostatic panels that can handle large amounts of power in ordinary air. (Dayton Wright uses a sealed, gas-filled environment.) The One/A is a very respectable speaker system; offhand we can think of only three others that will give you even greater clarity, better detail, and a cleaner impression overall, all at a higher cost: our own Reference A (which also uses Koss panels in the midrange), the Mark Levinson HQD System, and the Beveridge; but the latter can't play nearly as loud. The Koss does have a "clubfoot" though; there's a rather severe and intractable high-Q resonance at 50 Hz, which tends to dump colorations into the lower midrange. With a little cleaning up this speaker could become a very good buy even at its increased price.

Ohm F

Ohm Acoustics Corp., 241 Taaffe Place, Brooklyn, NY 11205. Ohm F 'coherent sound' speaker system, $1400 the pair.

The single-driver Walsh principle really works, up to a point; the Ohm F reproduces pulses of all widths with remarkable coherence. The large metal cone (deployed with its convex side out and apex up) creates tremendous energy storage problems, however; the ringing we measured at numerous frequencies throughout the speaker's range was among the worst in our experience. The resulting sound is extremely colored and inaccurate; in addition, the bass is a bit on the loose side (Q = 1.4).

Pyramid 'Metronome'

Pyramid Loudspeaker Corporation, 131-15 Fowler Avenue, Flushing, NY 11355. Metronome Model 2 + 2W speaker system, $2600 the pair.

We're told that the current production model is greatly improved over the one we tested; we certainly hope so because we didn't think at the time that the Metronome was of reference quality. We admired its tremendous dynamic range and its freedom from the usual gritty/spitty kind of distortions, but found its bass response rolled off and its overall sound to be lacking in the openness, transparency, airy delicacy, and definition of inner detail we expect of an "ultimate" speaker. Frequency response and time response were constantly being traded off against each other in weekly modifications of our original test samples. We're planning to review the "final" version in the next issue.

Rogers LS3/5A

Reference Monitor International, Inc., Suite 309, 4901 Morena Boulevard, San Diego, CA 92117. Rogers LS3/5A BBC Monitor Loudspeaker, $499 the pair.

This was the speaker that established the highly successful minimonitor format: clean and fast tweeter, small midrange/woofer cone, careful attention to the crossover, tiny but very rigid sealed box. It really isn't possible to do much more with conventional dynamic speakers if you're excluding the bottom two octaves (say, 20 to 80 Hz), and the Rogers remains to this day one of the better examples of the genre. The Tangent RS2 sounds a little sweeter and better focused; the Fried B/2 and Symdex Sigma are definitely less colored; but the Rogers is the one that showed us it can be done. The day we heard it we sold our Dahlquists.

Snell Acoustics Type A

Snell Acoustics, 10 Prince Place, Newburyport, MA 01950. Type A loudspeaker system, $1370 the pair.

The ultimate embodiment of the frequency-response-is-everything school of thought. The Snell is almost amplifier-flat (plus or minus close-to-nothing) from 38 to 22 kHz; its -3 dB points are at 28 Hz and 23 kHz. What's more, virtually flat response is maintained over an amazingly wide angle. On the other hand, absolutely no effort is made to synchronize the three drivers in the time domain; the response is totally noncoherent. Thus, even though the sound is extremely clean, balanced and solid, there's a lack of ultimate clarity and focus. An improved version is reported to be just out as we go to press; we hope to have a chance to review it, as this is certainly not a negligible design.

Spendor BCI

RCS Audio International, Inc., 1314 34th Street NW, Washington, DC 20007. Spendor BCI vented-box loudspeaker, $700 the pair.

This is no Thiele/Small-aligned vented box; it has a +6 dB hump at 72 Hz in the composite response of woofer and vent, and it booms very audibly. The frequency response is otherwise fair, with some crossover troughs; pulse form retention is very good but with some trailing hangover. The sound is basically in the civilized Rogers/Tangent vein, but not quite as smooth and transparent; the midrange is a bit rough. Add that to the boomy bass and the speaker begins to look very overpriced.

Tangent RS2

Tangent Marketing of America, Inc., 12 Irving Street, Framingham, MA 01701. RS2 Reference Speaker, $519 the pair.

Except for its grossly underdamped bass (sealed box, +8 dB at 75 Hz, Q approximately 2.5), this is one of our all-time favorite dynamic sepakers, mainly on account of its excellent deployment of the KEF T27 tweeter. The top end goes out dead flat almost to infinity (well, 32 kHz, okay?) and sounds that way, too—very open, clean and well-defined. The pulse response is outstanding, surpassed in this type of speaker only by the Symdex Sigma, and that only because the Tangent's tweeter is out of phase; you can't really call it a perfectly time-coherent system for that reason. There's some ringing in a few places but nothing terribly serious. What's more, the speaker handles power quite well, making it a genuinely useful monitor, especially in view of its portability (14½" x 11¼" x 10").

Ultraphase 2501

Ultraphase, 2875 South Raritan Street, Englewood, CO 80110. Model 2501 floor-standing speaker system, $596 the pair.

A rather unusual design, utilizing a staggered array of two domes and a heavily overdamped 8" woofer in an enclosure of battleship-like solidity. The result is extremely tight, though not very deep, bass and clear, well-focused, ambience-detailed sound, but with a definite edginess seemingly due to ringing. A more sophisticated speaker has meanwhile been announced by Ultraphase; we're looking forward to testing it.

Power Amplifier Postsurvey: Mop-Up and Afterthoughts

By the Staff
of the Audio Critic

You didn't really think our "final installment" in the last issue was final, did you? New things are happening all the time and old things appear different as a result. We pick up a few loose ends and look at seven more power amps, two of them SOTA contenders.

We still don't have a program of amplifier measurements we can fully correlate with what we hear in our listening room. Our announcement in the last issue of the imminence of such a program was premature; we had gone a bit overboard after reading the engineering paper by Leinonen and Otala on the five basic distortion mechanisms in amplifiers and the most sensitive measurement techniques to identify them. Our subsequent investigations convinced us that, even though the two Finns are absolutely right as far as they pursue the subject, their methods will not pinpoint on the test bench the difference between an amplifier that sounds excellent and one that sounds even better—which is, of course, what **The Audio Critic** is looking for. We don't believe that anyone in the world today has a "black box" test program capable of predicting the sound of an amplifier simply by feeding test signals into the input and measuring them at the output, without looking inside the box and analyzing the topology. There are just too many subtle nonsteady-state effects that don't show up on a meter or a CRT.

What black box tests do accomplish is to separate obviously flawed products from the basically decent ones. For that reason we continue to track through all our routine measurements on new amplifiers that come in, including THD, SMPTE-IM, CCIF-IM, square waves into resistive load, square waves into reactive load, slew rate, propagation delay, recovery time, output minus input on pulse-type information, and a few other little tricks that we make up as we go along. But we must confess that our heart isn't in it; the difference between satisfactory and superb results on the lab bench isn't reflected in the sound. Poor results are always audible, on the other hand, so that the bench tests aren't a total waste of time.

We're still convinced that feedback plays the decisive role in creating the differences we hear. Most amplifier designers don't use feedback correctly because they don't fully understand its consequences. (See also Robert Cordell's letter to the Editor in this issue and Andy Rappaport's letter in the last issue.) We get especially nervous when we measure vanishingly low THD at high power levels; it generally indicates that someone poured on the feedback indiscriminately to be able to advertise those double-oh figures. That's not where it's at, fellas; forget about the goose eggs after the decimal point and worry instead about the way the amplifier behaves with complex reactive loads.

A note on the listening tests.

The amplifiers reviewed below were compared two or three at a time by successive insertion into our "Reference A" system (described elsewhere in this issue) and listening to each at some length, without the confusion and superficialities of rapid A-B-ing. Reference

A has gone through a number of evolutionary changes but was of course kept constant in the course of any given side-by-side comparison.

In some cases it was not possible to evaluate the amplifier under test through the three-way hybrid speaker system of Reference A, and conventional dynamic speakers had to be substituted. Among the latter were the DCM Time Window, the Tangent RS2 and the Symdex Sigma. These, too, were kept constant for each particular comparison, but nearly all the amplifiers tested were eventually heard through all speakers. In addition to phonograph records played on the Reference A turntable, our source material included 30-IPS master tapes played on a modified Studer A80 with Mark Levinson electronics.

Audionics PZ3-II

Audionics, Inc., Suite 160, 10950 SW 5th, Beaverton, OR 97005. PZ3 Series II stereo power amplifier, $499 ($589 with VU meters). Three-year warranty. Tested #05203, on loan from dealer.

This 100/100-watt unit isn't quite as successful in circuit concept as the later, smaller and somewhat less expensive CC-2. Not that the PZ3-II is a bad amplifier, but Audionics has meanwhile come a long way in amplifier design philosophy, and we suspect that the days of this older model are numbered. Its sound is definitely not as transparent and unstrained as that of the CC-2, being somewhat edgy and hollow by comparision. The bass is nice, though.

On the test bench we found no obvious anomalies to account for what we were hearing.

FM Acoustics FM-600A

FM Acoustics Ltd., CH-8702 Zollikon, Switzerland. FM-600A Laboratory Power Amplifier, $1650. Tested #00133, on loan from dealer.

Even though this 150/150-watt Swiss amplifier sounds very good, we can't see a niche for it in a world where there exist even better-sounding amplifiers for considerably less money. There appears to be a definite hardness and glare in the sound of the FM-600A (one of our keenest auditioners described it as a phosphorescent quality), which has been "bred out" of today's most successful designs. Don't misunderstand us; we aren't talking about a major flaw. But the Audionics CC-2, at less than one third the price and half the power, sounds distinctly cleaner and sweeter.

In our square wave tests, a 2-microfarad capacitor across the 8-ohm load resistor induced an overshoot of 125% followed by gobs of undamped ringing. Feedback problems, no doubt, which may have had something to do with what we heard.

Futterman H-3aa
(Improved)

Futterman Electronics Lab, 200 West 72nd Street, New York, NY 10023. H-3aa vacuum-tube power amplifier, $895 (stereo pair on two chassis). Tested samples on loan from manufacturer.

This latest version of the Futterman tube amplifier still isn't the final version that will most probably be made in larger quantities and (cross your fingers) sold in stores. That one is still in the experimental stage; what we have here is the version Julius Futterman is currently making for his private clientele and delivering at the rate of approximately one pair per aeon. This one is biased more nearly as a class A amplifier than its immediate predecessor and also incorporates a few other circuit changes, none of them particularly radical. The sound, though, is radically improved.

This is absolutely the clearest, most open, most focused sound we have ever heard out of a power amplifier. The experience is of a wholly new order. No other amplifier is quite in the same class, not even the Mark Levinson ML-2 or the Rappaport AMP-1. On the other hand, the latter are considerably more useful for typical applications, since the Futterman is quite unhappy with loads below 8 ohms or so and really comes into its own only at 16 ohms and beyond. (It's ideal for driving the superb Pyramid Model T-1 ribbon tweeter, for example). Into 8 ohms, the Futterman goes into very soft clipping between about 55 and 70 watts; when pushed further it clips quite decisively. It shouldn't really be used with speakers that drop below, say, 6 ohms

anywhere in the audio range—and that excludes a lot of speakers. It's a pity, especially since the Futterman isn't upset by capacitive loads at all and would be really nice with electrostatic speakers if it weren't for the extremely low-impedance upper range of the latter. But that's the nature of an output-transformerless tube amplifier.

Incidentally, the Futterman uses lots of feedback, proving that if you design an open loop with as little delay from front to back as this one, you can get away with it. Tubes make it easy. The resulting steady-state distortion figures are decently low without being a threat in the DB Systems kind of numbers game.

We must come back to that utterly transparent sound, though; veteran audio cynics listen to it with their jaws several notches lower than the code permits. It's ironic that this should be happening in a world from which the power tubes Julius Futterman is using will surely disappear in a few years, since the only commercial demand for them is as replacements in ancient TV sets.

Kenwood L-07M

Kenwood, PO Box 6213, Carson, CA 90749. L-07M mono power amplifier, $450 (stereo pair, $900). Tested #620130 and #650042, on loan from dealer.

This is one of the new family of Kenwood components making a bid for the sophisticated audiophile's dollar, but not very persuasively if you ask us. To our ears it sounds horrible. Mushy, edgy, fuzzy, totally degraded—words fail us.

On the test bench the L-07M comfortably puts out 150 watts into 8 ohms, but when it clips it does so with hair-trigger abruptness and extraordinary violence. There's no transition between ultralow distortion and 100% garbage. With 2 microfarads across an 8-ohm load resistor, square waves show 140% overshoot and totally undamped ringing. Obviously the amplifier has been designed for super specs with huge amounts of feedback. That makes for good reading, Kenwood, but bad listening.

Some people have kind words to say about the L-07M as a bass amplifier in biamped systems (it's DC coupled and all that jazz). After hearing it full-range, we too are quite certain that it sounds better topless.

Rappaport AMP-1

A.S. Rappaport Co., Inc., Box 52, 530 Main Street, Armonk, NY 10504. Model AMP-1 stereo power amplifier, $1800. Three-year warranty. Tested two prototype samples, on loan from manufacturer.

As we go to press, there are only four samples extant of this, the world's first no-feedback transistor power amplifier, two of which have passed through our hands and one of which we still have on loan. We hesitate to make sweeping predictions about the production version of the Rappaport AMP-1 based on this experience, even though we're told that the circuitry of our present updated sample is final and that the production model has no place to go but up in performance as a result of even better parts and better physical construction. We'll report on that when we have one; the unit is scheduled to be in full production before the end of 1978.

Meanwhile we can only judge what we have on hand, and that's very impressive indeed. In a carefully controlled A-B listening comparison of a single AMP-1 with two bridged Mark Levinson ML-2's per side (that's four chassis at $2000 each), the AMP-1 was unanimously preferred by a group of rather sophisticated auditioners as clearer, more detailed, more solid, more lifelike overall. That doesn't mean that we now declare the AMP-1 to be "better" than the ML-2. First of all, only dynamic speakers were used, no suitable electrostatic having been available at the time we had all amplifiers on loan. Nor had our reference ribbon tweeter, the Pyramid T-1, arrived yet. It's possible, though not probable, that through speakers with even higher resolving power the results would have been different. Furthermore, quite aside from sonic considerations, the Mark Levinson amplifier is built like a battleship out of the best parts money can buy and at the same time is completely modularized, so that evolutionary improvements can, and will, be implemented right in the field. The Rappaport, on the other hand, is very much an *ad hoc* design, the "hoc" being the best achievable sound today and never mind tomorrow.

Actually, when it comes to sheer sound quality, we prefer the latest Futterman over the AMP-1 by a small but decisive margin (see the

H-3aa review above); however, the Rappaport has so much more headroom with typical low-impedance loads that it's a far more practical choice in most applications. You can get 27 to 28 clean volts per channel out of the AMP-1 almost regardless of load impedance; into 4 ohms, for example, that's close to 200 watts. In fact, for sheer output capability, the AMP-1 is almost the exact equivalent of bridged ML-2's at less than one fourth the price.

Our greatest misgiving about the AMP-1 prototypes we've examined has to do with the amount of heat the amplifier generates. Andy Rappaport's design philosophy requires very high junction temperatures to be maintained in the transistors at all times (see also his letter to the Editor in the last issue), and he uses every bit of metalwork on the amplifier as one big heat sink. We don't disagree with his technical arguments on this subject but take vigorous exception to the physical design of the amplifier chassis and case. The top, the front panel, the carrying handles, the on/off switch are all dangerously hot to touch, and the finned sides where the output transistors are mounted actually exceed 100° C (212° F) after prolonged operation, making droplets of water go "pst" like an iron that's ready for pressing pants. We fear that this will give pause to audio purists with small children, pets, accident-prone in-laws, or tight equipment cabinets. We see no absolute necessity for burning-hot handles just because the transistor junctions must be hot. It remains to be seen how this problem will be dealt with in the production model. The life expectancy of transistors, capacitors and other components in this superheated environment is another matter altogether, presumably attended to in the specs for the parts list. We certainly hope so.

As for the feedbackless circuit design, it really gets around the typical time-domain-related problems at one fell swoop; our bench tests bear that out. They also indicate more than the usual amount of ordinary amplitude-related distortions; where other amplifiers yield single-oh figures, the AMP-1 flirts with the point-three and point-four region when you begin to push it. We're reporting this in such a cavalier fashion because we don't attach much importance to it; we really don't think that the difference between, say, 0.035% and 0.35% THD is where the integrity of an audio signal hangs in the balance. Maybe an amplifier with an open loop just as clean as the Rappaport's and a few dB of feedback around it to bring these distortions down 0.1% or so would sound even better; maybe not. Andy Rappaport says certainly not; he believes that the perpetually out-of-date error-correcting signal applied to the input of a feedback amplifier causes a regeneration of distortion that's invariably audible. We suspect that he is at least partly right; however, there must exist a threshold of perception in this process as in all auditory phenomena. We expect to have more to say on the subject in the future; meanwhile we can report that Andy, who recently had his 21st birthday, is entering adulthood with a very good first amplifier.

Series 20 Model M-22

Series 20 (a division of Pioneer Electronic Corp.), 75 Oxford Drive, Moonachie, NJ 07074. Model M-22 class A stereo power amplifier, $790. Two-year warranty. Tested #XI3200510M, on loan from manufacturer.

Pioneer is doing a bit of high-end colonizing here, just like Kenwood, but at least they had the decency to assume an alias for the purpose. Besides, this is a much more respectable effort than the Kenwood amplifier reviewed above.

The sound of the M-22 is pleasant and nonfatiguing but not as transparent and detailed as that of other class A amplifiers we've tested. We hear a dull, veiled, almost opaque quality that in our judgment keeps this beautifully made product out of the top category, even on a value-per-dollar basis. On the other hand, it's rugged, reliable and sonically inoffensive, which is more than we can say about most amplifiers. The 30/30-watt power rating at 8 ohms reflects the penalties of class A operation but is quite conservative; at 40 watts it's good-bye Charlie.

Our routine series of measurements revealed no satisfactory reason for the dull sound of the M-22.

Stax DA-80

American Audioport, Inc., 1407 North Providence Road, Columbia, MO 65201. Stax DA-80 class A DC stereo power amplifier, $1700. Tested #0187, on loan from dealer.

This class A stereo amplifier from Stax In-

dustries of Tokyo gives you 45/45 watts into 8 ohms, exceptionally clear, sweet and well-balanced sound, and a royal pain in the pocketbook. We wish we could say it was worth the money, but we can't. The Futterman easily beats it at its own game (clarity and unstrained ease) at about half the price and is somewhat more powerful to boot; the Rappaport AMP-1 is also far superior sonically and provides twice the power for only $100 more. In Japan, if your brother-in-law owns a hi-fi store, the DA-80 is probably still a terrific buy. We certainly don't fault it, except by comparison. The best is the enemy of the good.

In our lab tests the DA-80 behaved very well in every respect; we were amazed by its bandwidth, evidenced by a small-signal rise time of 500 nanoseconds. If you've read our review of the Cotter NFB-2 subsonic/ultrasonic filter, you know how little store we set by that sort of thing, but it's always interesting to observe the numbers games audio designers play.

Recommendations

Our top choices entail certain unavoidable trade-offs this time, so we must emphasize the necessity of referring back to the actual reviews to avoid simplistic conclusions based on this summary alone.

Best-sounding power amplifier tested so far, regardless of price, but with serious practical limitations: Futterman H-3aa (latest mod only, more into class A).

Best-sounding general-purpose power amplifier, with serious reservations about physical design: Rappaport AMP-1.

Best-sounding power amplifier requiring no caveats: Mark Levinson ML-2 (or bridged ML-2's for more power).

Close to the best at a much lower price: Audionics CC-2.

Power Amplifier Summaries and Updates

All of the following were reviewed in Volume 1, Numbers 2, 4 or 5. Some are of little or no current interest either as SOTA contenders or even as good sound per dollar.

Audionics CC-2

Audionics, Inc., Suite 160, 10950 SW 5th, Beaverton, OR 97005. CC-2 stereo power amplifier, $489.

One of the all-time "best buys" in high fidelity, even at its new price. Within its power limitations (70/70 watts into 8 ohms, considerably more into lower impedances) it comes amazingly close in clarity, resolution of detail and unstrained ease to the best amplifiers, regardless of price. Current samples we've checked are better than ever; watch out, though, for some earlier ones delivered with the bias set too low, an easily correctable condition. In its bridged mono mode, rated at 225 watts into 8 ohms, we aren't quite as sold on it; we'd like to see a heavier power supply, with greater current capability, for the kind of service high-wattage amplifiers generally end up in.

Audio Research D-100

Audio Research Corporation, 2843 26th Avenue South, Minneapolis, MN 55406. Model D-100 stereo power amplifier: no longer available in the version reviewed.

The 100/100-watt solid-state D-100 we tested has been superseded by the similarly rated D-100A, at $1195. We didn't particularly like the D-100, even for $200 less; it sounded rather blunted and lacking in high-frequency transient detail as well as in bass definition.

Bryston 4B

Bryston Manufacturing Ltd, 57A Westmore Drive, Rexdale, Ont., Canada M9W 4M1. Model 4B stereo power amplifier, $1295.

Quite possibly still the best of the very high-powered amplifiers (200/200 watts into 8 ohms, 400/400 into 4 ohms), even though it sounds just a wee bit hard and zippy compared to our current favorites. We've heard from fairly reliable sources that the latest production units are substantially better than what we tested; if that's true we may want to take another look soon.

CM 912a and CM 914

Audio International, Inc., 3 Cole Place, Danbury, CT 06810. CM 912a and CM 914 stereo power amplifiers, $899 and $449, respectively, when reviewed.

We're not quite sure whether these units are still available; this company seems to be taking the disco sound systems route. It matters very little, in any event, since both the CM 912a and the CM 914 have been left far behind by newer developments in the same price range. We were never fully convinced of the engineering savvy of these people and we've also had a very negative experience with them as regards their business ethics.

D B Systems DB-6

D B Systems, PO Box 187, Jaffrey Center, NH 03454. DB-6 stereo power amplifier, $595.

This is a 40/40-watt amplifier designed with lots of negative feedback to achieve the ultralow THD figures dear to

the heart of this company. It sounds strangely homogenized and lacking in spatial detail, a time-domain distortion of far greater consequence than some low-order harmonics. Not our cup of tea.

Electrocompaniet

Electrocompaniet, Toyen Gt. 14, Oslo 1, Norway. "The Two-Channel Audio Power Amplifier" (reviewed at an early stage of its development): current price NA.

We've been promised a greatly improved new version of this almost legendary little amplifier (25/25 watts into 8 ohms, 40/40 into 4 ohms), which was already very close to SOTA when we had our first look at it. The circuit was very up-to-date in concept, originating from Matti Otala, and the sound was exceedingly clear and detailed, surpassed only by our latest generation of top choices. We're looking forward to reporting on the improvements, probably in the next issue.

GAS 'Son of Ampzilla' and 'Grandson'

The Great American Sound Co., Inc., 20940 Lassen Street, Chatsworth, CA 91311. 'Son of Ampzilla' stereo power amplifier, $519; 'Grandson' stereo power amplifier, $379 (with meters).

We're lumping these two together because they represent the same design philosophy, originating from the same source, with incorrect use of feedback in our judgment. The sonic results are quite disappointing; the Audionics CC-2, which is competitive in price and power output with the Son, sounds astonishingly more transparent, detailed and nonfatiguing. As for Grandson, we find it unlistenably hard and sizzly. Both Son and Grandson ring like crazy with capacitive loads.

Luxman M-4000

Lux Audio of America, Ltd., 160 Dupont Street, Plainview, NY 11803. Model M-4000 stereo power amplifier, $1595.

A beautifully made, rugged, obviously reliable 180/180-watt unit, inexcusably hard and opaque in sound for this price category. We suspect typical feedback problems, probably traceable to mandatory Japanese specmanship.

Mark Levinson ML-2

Mark Levinson Audio Systems, 55 Circular Avenue, Hamden, CT 06514. ML-2 class A power amplifier, $2000 (per mono chassis).

This is almost unquestionably the world's best-made power amplifier, further enhanced in value by completely modularized construction to facilitate future updates (it comes apart like an Erector set). At this writing, we rate it behind the latest Futterman and the new Rappaport in sheer sound quality (see reviews above), but that rating could quite possibly change in view of the ML-2's evolutionary capability. Since we have various non-sonic reservations about both the Futterman and the Rappaport, the ML-2 remains our top choice for those who wish to play it absolutely safe and don't care about the cost. As a result of fully class A operation into all loads down to 2 ohms, the output capability of the ML-2 is limited (not quite 15 volts out into all such loads), so that bridging two of them per side becomes necessary for power-hungry applications. For $8000, that gives you approximately 210 watts per channel into 4 ohms, half as much into 8 ohms. Call your friendly neighborhood loan shark.

Quad 405

Acoustical Manufacturing Co. Ltd., Huntingdon, Combs. PE18 7DB, England. Quad 405 "current dumping" stereo power amplifier, $480.

We recommend this only as a reasonably priced choice for driving the Quad electrostatic safely; as a general-purpose amplifier the Audionics CC-2 gives considerably better sonic results at the same price. The ultimate voltage-limited amplifier for the Quad electrostatic is the Mark Levinson ML-2.

Quatre DG-250

Quatre, 21356 Deering Court, Canoga Park, CA 91304. DG-250 Gain Cell stereo power amplifier: no longer available in the version reviewed.

The original version turned out to be unreliable and a frequent destroyer of speakers, forcing us to withdraw our recommendation of it despite some highly attractive sonic qualities, plus not far from 200 watts per channel, for very little money. The new DG-250C ($575) may or may not have solved the problem; we haven't tested one yet. In any event, the Audionics CC-2 is sonically superior to the original version.

RAM 512

RAM Audio Systems, Inc., 17 Jansen Street, Danbury, CT 06810. RAM 512 stereo power amplifier: no longer available in the version reviewed.

The last version we saw listed is the 512A at $1250; if it sounds as hard, bright and smeared as the original 512 we tested, it isn't worth that kind of money, even at the increased rating of 200 watts per channel into 8 ohms.

SAE 2400L

Scientific Audio Electronics, Inc., PO Box 60271, Terminal Annex, Los Angeles, CA 90060. 2400L stereo power amplifier, $850.

Somewhat opaque, closed-down, lacking in transient detail and yet slightly aggressive on top. The feedback blues, no doubt, confirmed by circumstantial evidence on the test bench. It's nice to have 200 watts per channel at this price, but not with this kind of sound.

Threshold 800A

Threshold Corporation, 1832 Tribute Road, Suite E, Sacramento, CA 95815. Model 800A class A stereo power amplifier: no longer available in the version reviewed.

The nearest thing to this discontinued unit on the current Threshold list is the Model 4000, also a 200/200-watt amplifier with "dynamic bias" for alleged class A operation (ahem, ahem), but at a much lower price—a mere $1825. Apparently the super deluxe packaging of the 800A didn't prove to be practical. It was never worth the original $2275, anyway; even the Bryston 4B sounded more open and better focused at about half the price, and since then there have been further advancements at several price points. We must add that this company has from the very beginning struck as being into "head trips" about advanced circuitry and laboratory measurements rather than the realistic analysis of what we actually hear.

Yamaha B-2

Yamaha International Corp., 6600 Orangethorpe Avenue, Buena Park, CA 90620. NS Series B-2 stereo power amplifier, $850.

There was a lot of ballyhooing about this 100/100-watt vertical-FET power amp when it first came out, but there are any number of better amplifiers today for the money. The B-2 was overbright and irritating even for its own generation; by late-1978 standards it isn't acceptable. Too bad; it was very beautifully made and well conceived in its inputs, controls, meters, and other aspects of physical design.

Preamps Without End (They Still Keep Coming)

By the Staff
of the Audio Critic

Nothing in audio changes faster than the preamp scene. Here we go again: the latest developments, some interesting add-ons and plug-ins, and completely new top choices.

Before you get too deeply into this, we must ask you to read our introduction to the power amplifier reviews in this same issue, since preamps resemble quite closely the low-level stages of power amps and impose the same frustrating limitations on sonically correlatable laboratory measurements. It would be repetitious for us to make the same observations here about our second thoughts on the subject and about our current procedures, so please refer back to the other article.

That old villain, the RIAA curve.

One thing that makes preamps different from power amps, though, is that the first stage of a preamp must handle a preequalized input signal. The sharply boosted high frequencies of the RIAA recording characteristic have been the downfall of many a preamp design. When those high velocities are accurately traced by the stylus and transmitted to the preamp input more or less intact (as they appear to be by our extraordinarily "fast" reference cartridge, the Fidelity Research FR-1 Mk 3F, through the Cotter transformer), that first stage just goes "crunch" in some very highly respected preamps.

The truth is that the RIAA preemphasis curve should never have been standardized in its present form; the 6-dB-per-octave high-frequency boost should have been stopped with a shelf at, say, 7 kHz. That's not a very hopeful cause for a reformist after 25 years; on the other hand, the utterly wrongheaded new IEC Recommendation (to roll off the RIAA playback curve 6 dB per octave on the bottom end, with the -3 dB inflection point at 20 Hz) may still be resisted before it becomes an RIAA Standard. We editorialized at some length on this in the last issue and are glad to observe that most preamp designers have thus far been ignoring the whole silly business. Unfortunately, they've also been ignoring our remarks about the wrong topology in RIAA equalization networks; too many preamps show the typical saddle-and-hump error curve that results. Stanley P. Lipshitz of the University of Waterloo (Ontario, Canada) recently struck a resounding blow on behalf of accurate RIAA equalization with an outstanding Audio Engineering Society paper that analyzes the subject in depth and fully corroborates our inevitably less authoritative journalistic carping.

Measuring the RIAA equalization error is

of course one respect in which our laboratory tests on preamps differ from those on power amps, and the data obtained are generally more revealing than most. We consider a measured error of ±0.2 dB to be tantamount to perfect equalization; ±0.5 dB begins to verge on audibility; in between we're not so sure. We must hasten to add that amplitude response errors never sound as unnatural as high-frequency cross-modulation effects, which are probably the most common form of audible preamp distortion but very hard to catch on the wing.

Tubes vs. transistors.

Since two of the best preamps we've come across lately are vacuum-tube units, we want to make sure that the prevailing irrational cultisms on the subject don't rub off on us by implication. We don't believe that electrons have any memory of the type of device they've passed through. The waveform of an audio signal is either altered or not as it passes from input to output through a circuit. We hear the alterations, if any, not the nature of the circuit components. An unstinting application of either vacuum-tube or solid-state technology will preserve the waveform with the same accuracy, provided that the circuit designer doesn't lapse into conventional errors. There's the rub.

"Tube sound" and "transistor sound" should be reworded as "sound due to typical tube-circuit design errors" and "sound due to typical transistor-circuit design errors." That doesn't mean, of course, that the choice between the two is six of one and half a dozen of the other. The vacuum tube is a natural audio amplification device; the transistor must be manipulated. An untutored tube-circuit designer is therefore more likely to get good results than an equally untutored transistor-circuit designer. On the other hand, tubes are not nearly as stable and reliable in the long run as solid-state devices, so that the more complex manipulations to make the latter behave are mandatory for the future of audio and already successful in the present state of the art, though not much below that level.

Okay? Are we still nondenominational?

The listening tests.

The preamplifiers under test were inserted into our "Reference A" system (see article in this issue) and compared two at a time with the gain on all channels set equal within 0.25 dB when playing the 1 kHz reference tone on a standard test record.

With the accurate tracing of fast transients by the reference pickup, no low-frequency garbage fed back by the reference turntable, plus the high resolution of this unsmeared information by the reference speaker, the differences heard from preamp to preamp were quite startling. Genuine cleanliness of sound was the exception rather than the rule; a slightly but perceptibly raunchy quality was added even by our previous top choices; and we began to realize that, when reviewers prefer the "liquid" highs of this one but not its "hooded" midrange and the front-to-back "depth" of that one but not its "warm" upper bass, they're talking about their personal taste in the distribution of sonic crud, without having a clean reference. Clean is clean and there's no mistake about it; it just happens to be rare and expensive—and never so absolutely clean that something cleaner won't come along eventually.

Apt/Holman

Apt Corporation, 147 Sidney Street, Cambridge, MA 02139. Holman Preamplifier, $493. Three-year warranty; manufacturer pays return freight. Tested #01124 and #02060, on loan from manufacturer; also third sample, on loan from dealer.

This is one of the better preamps around, at any price, and easily the best for the money. For a short time it was actually our reference preamp, but we ended up ranking it sonically in fifth place behind the Precision Fidelity C4, Audio Research SP-6, Mark Levinson ML-1 (very latest production only), and Hegeman HPR/CU (ditto). The first three are in a totally different price class; the Hegeman costs only about 50% more but doesn't have the Apt/Holman's control facilities.

Those control facilities are, we must hasten to add, beautifully thought out and executed with impressive quality. The L + R (in-phase blend) and L - R (out-of-phase difference) modes are alone worth the price of admission. The entire unit is well made, handsome, a pleasure to use, and quite excellent in sound. Not for nothing has Tom Holman devoted the past few years of his life to studying, and writing about, preamplifier design.

Judged against all comers, however, the Apt/Holman still falls somewhat short of state-of-the-art performance. It sounds very open, smooth and balanced (the RIAA equalization is accurate); it images well (unusually good channel separation may have something to do with that); but its high-level stage does add a little zip to the input signal on a bypass test, and its phono stage isn't absolutely comfortable with the most vicious leading edges traced by a fast cartridge, though better in that respect than most. In other words, it's a pretty clean preamp but not the cleanest preamp known to us.

Very important: the Apt/Holman is one preamp you should definitely keep turned on for many hours, preferably a day or more, before you judge it. Our first sample sounded absolutely awful (hard and zippy) when we first plugged it in and later improved spectacularly. Tom Holman himself pooh-poohs this observation, but we were there and he wasn't. Audiophiles who expressed disappointment to us about the Apt/Holman had without exception listened to it without warm-up.

Audio Research SP-6

Audio Research Corporation, 2843 26th Avenue South, Minneapolis, MN 55406. Model SP-6 vacuum-tube preamplifier, $1075. Three-year warranty. Tested #58207014 and #78307052, on loan from dealer.

The SP-6 is essentially an SP-3A-1 without tone controls and tape copy features, the only major difference being a more advanced power supply. There are also minor circuit changes, but the basic topology is the same. The sound, however, is vastly improved.

Actually, our first sample of the SP-6 sounded terrible, so bad that we returned it almost immediately. We were told it was a defective unit that had been back to the factory and inadvertently shipped out again without repair. On our test bench it didn't look obviously defective; in fact it appeared identical on all routine measurements to our second sample, which sounded the way we presume an SP-6 should. Just a minor mystery, but it does jibe with some persistent disagreements out there about the sound of the SP-6. Maybe, just maybe, they don't all sound the same.

Our second sample sounded excellent, we must admit. The highs were really clean; we convinced ourselves that the high-level stage was cleaner than that of the Mark Levinson ML-1, adding no trace of zip or smear on a bypass test, even with lots of high-frequency energy in the input signal. The phono stage, which is virtually identical to the high-level stage except for RIAA equalization in the feedback loop, has some problems, but it still sounds better than most phono stages. It does introduce some upper bass and lower midrange whomp, which we found much less distressing than the high-frequency garbage in nearly all transistor preamps, but that doesn't mean we condone it. This is almost surely a time-domain phenomenon, probably attributable to the feedback equalization. Not that all is well in the frequency domain; the RIAA equalization error is the worst we've ever measured in an expensive preamp: ± 0.75 dB (actually +0.7, -0.8), consistent in both samples. (See our remarks above about incorrect EQ networks; this is a classic case.) The resulting unbalance is clearly above the threshold of audibility; the sound of the SP-6 has a "signature" as a result. We also measured some asymmetrical distortion on preequalized square waves through the phono stage; it may conceivably have been a lower threshold on this same effect that made our first sample sound distorted.

In spite of all these reservations, we rate the overall sonic performance of the SP-6, from phono input to high-level output, very high indeed. The complete freedom from dynamic stress at the higher frequencies, the superior definition of inner textures and ambience details, the general subjective impression of immediacy, the absence of burrs and gargles and other little roughnesses all add up to a very listenable preamplifier.

What's better? The Precision Fidelity C4 tube preamp, for one thing; it equals or surpasses all these virtues of the SP-6 and avoids its faults. The Cotter PSC-2 phono stage, when plugged into one of the "aux" inputs of the SP-6, makes a much more accurate phono preamp out of it. The production version of the Rappaport PRE-3 also promises to be superior. As for the Mark Levinson ML-1, the very latest factory-tweaked edition we compared against the SP-6 sounded more balanced, more neutral (no signature), tighter in the bass, but not as clean, detailed and just plain real.

That's all. No others we know of are as good.

Cotter NFB-2

Mitchell A. Cotter Co., Inc., 35 Beechwood Avenue, Mount Vernon, NY 10553. NFB-2 Noise Filter/Buffer, $350, with PW-2 Master Power Supply, $200. Five-year warranty. Tested #F2-124399, owned by The Audio Critic.

This is one of the new products Mitch Cotter is currently making under his own name; it had been announced in an earlier version as the Verion NF-1, which never made it into production for legal reasons. It isn't a preamp, actually; it goes between the preamp and the power amp. Eventually it will expand into a complete system of modules powered by the PW-2 master power supply (four sockets for four modules), the sum total of which will be a super "front end" for the audio purist.

What the NFB-2 does is to keep useless and potentially disruptive subsonic and ultrasonic signals out of the power amplifier and speaker. In other words, it acts as a high-pass and low-pass filter, but of a very sophisticated variety. Ordinary bandwidth-limited devices cause time-domain changes in the signal that are audible, even though the "corners" are outside the audio range. The NFB-2 is time-domain corrected to maintain these changes below the threshold of hearing. Its low-frequency corner is around 16 to 18 Hz; the high-frequency corner is somewhere between 35 and 40 kHz. The corners themselves aren't very sharp, hence our somewhat vague location of them; beyond those frequencies, however, the NFB-2 really stonewalls it. The rise time through the filter/buffer is 9 microseconds.

Mitch Cotter's rationale for the NFB-2 is (1) that the human ear is insensitive to rise times faster than approximately 14 microseconds, (2) that no power amplifier, not even the "fastest," is really happy with superfast, high-amplitude transients, (3) that tweeter voice coils are unable to take the G forces generated by high-amplitude signals in the hundreds of kHz, (4) that there's lots of garbage below 16 Hz but no enjoyable audio information, and (5) that the DC-to-light audio design philosophy is therefore the rankest nonsense, since bandwidth limiting is possible without audible time-domain effects if the designer knows what he is doing.

Our own experience with the NFB-2 fully supports these points. We have yet to insert it into a system, no matter how well-designed or expensive, that didn't sound cleaner as a result. The device is completely transparent, introducing no sound of its own even though it has an active stage; it's just that the rest of the system sounds clearer, sweeter, better focused with it than without it. The difference is especially noticeable on transients such as cymbal clashes; the NFB-2 takes out the lower-pitched haze, leaving only the clean metallic overtone structure of the shuddering brass. Obviously, amplifiers that are the least perturbed by out-of-band transient spikes show the least difference; but even the Rappaport AMP-1, the champion in this respect, sounds distinctly better when driven through the NFB-2. The low-frequency effects are less dramatic; it's just that there are no more subsonic problems with vented speakers, no more tripping of protective circuits with thumps, pops and other low-frequency transients, etc., etc.

Once again, Mitch Cotter has demonstrated to us where the real priorities are in audio. Needless to say, if preamplifiers were designed with a similar output stage, or power amplifiers with a similar input stage, there'd be no further need for the NFB-2. Fat chance.

Cotter PSC-2

(preview)

Mitchell A. Cotter Co., Inc., 35 Beechwood Avenue, Mount Vernon, NY 10553. PSC-2 Phono Signal Conditioner, $350, with PW-2 Master Power Supply, $200. Five-year warranty. Auditioned manufacturer's pre-production prototype.

This is another of the Cotter "blue bricks" that plug into the PW-2 power supply. It's an RIAA-equalized phono stage, to be connected to the "aux" input of a good (that's a must!) preamp/control unit. Eventually, Cotter will come out with such a unit; meanwhile not even the PSC-2 is out as we go to press, but we're told it will be in production before the end of 1978. This is just our initial impression of a very sloppy laboratory prototype we were allowed to borrow for a day. We had no time to put it through our usual series of tests; we simply listened.

All we can say at this point is that this may possibly be It—the preamp that does everything better than all the others. Tremendous clarity, unlimited headroom (well over 120 dB of dynamic range is claimed), very low noise,

super detail, no "character" at all, acid test for high-level stages—these were some of our observations before the prototype, put together with spit and glue, went on the blink the very next morning. That's all we can tell you; it was tantalizing and frustrating. We can hardly wait to test a production unit for real.

The Cotter PSC-2 is thoroughly unconventional in design, as you might have guessed; it acts as a current amplifier (i.e., not as a voltage amplifier), utilizing some proprietary voltage-to-current conversion circuitry and no feedback. The RIAA equalization is passive. We expect to have a full report in the next issue.

DB Systems DB-1A

DB Systems, PO Box 187, Jaffrey Center, NH 03454. DB-1A Precision Preamp, $397, with DB-2 Power Supply, $62. Five-year warranty; manufacturer pays return freight. Tested #1030640/2030640, on loan from manufacturer.

This is the first "official" model change in the DB-1 preamp; the A suffix signifies tighter specs on the RIAA equalization (±0.07 dB, 10 Hz to 40 kHz, it says here), fancier control knobs, conformance with the new IEC Recommendation on the "phono lo-cut" switch, and similarly trivial differences. The sound remains the same as before: slightly closed-down and just on the verge of irritating hardness, without decisively breaking through the overt annoyance barrier.

"Only three things really matter in a preamp's performance," proclaims the DB Systems small-space ad. "1. Accuracy of frequency response. 2. Low noise. 3. Low distortion." Well, the phono equalization turned out to be almost as accurate as claimed (though no more so than that of the cheaper Series 20 Model C-21), and the noise was indeed low. When it comes to low distortion, the small print reveals that what they mean is THD from 20 Hz to 20 kHz (less than 0.0008%—wow!) and that's all, folks. Apparently no other form of distortion exists in New Hampshire. Time-dispersive distortions such as FIM and FXM must be a figment of some mad scientist's imagination. Feedback is the panacea; just pour on 40 dB more and you go from 0.08% to 0.0008%. *Sancta simplicitas!*

We made one very interesting observation when A-B-ing the DB-1A against the Apt/Holman, with which it competes almost dollar-for-dollar in the same market. The Holman sounded cleaner and more open, but when we turned its mode switch from pure stereo to partial L + R, thereby introducing some in-phase mixing, it sounded just as closed-down as the DB-1A. Subsequent bench testing revealed vastly superior channel separation in the Holman, even though the DB-1A still measured better in that respect than any actual phono cartridge known to us. But under dynamic conditions—who knows?

So we still feel what we always did about DB Systems; their heart is in the right place but their ear isn't. Nor is their design rationale.

Hegeman HPR/CU
(follow-up)

Hegeman Audio Products, Inc. (Hapi), 176 Linden Avenue, Glen Ridge, NJ 07028. Model HPR preamplifier with Model HCU control unit (incorporating power supply for HPR), $720 complete. Model HPR with Model HPS power supply (phono stage without controls), $360. Two-year warranty. Tested #201/196, on loan from manufacturer.

The production model of the Hegeman preamp is even better than the preproduction unit we reported on in the last issue. The sound is beautifully open, precisely focused, and clean; there's a see-through quality that comes close to, but doesn't quite equal, what we like so much about the two tube preamps reviewed here. The very latest factory-tweaked version of the Mark Levinson ML-1 is also superior in midrange clarity, overall smoothness and that ultimate subjective impression of accuracy, but there must be a lot of ML-1's out there that don't sound as good as the Hegeman. Ours certainly didn't before it came back from its third overhaul in a year and a half.

We have a few minor quibbles about some chintzy construction details in the Hegeman, but we still consider it to be the world's best production preamplifier at a three-figure price—and, despite the recent price increase, it isn't even close to the upper three figures. Or, if you don't need any control and switching functions, the HPR/PS combination at half the price will give you the necessary phono gain and EQ straight into your power amp. All you need is a pair of 5K ohm potentiometers for volume

control. Stew Hegeman is even toying with the idea of offering the pots as an accessory.

Precision Fidelity C4

Precision Fidelity, 1169 Chess Drive, Suite E, Foster City, CA 94404. C4 dual-cascode preamplifier, $1095. Three-year warranty (tubes one year). Tested #2020, on loan from manufacturer.

Among the preamplifiers reviewed here, this was the last to come in, and our exposure to it has been considerably shorter than to the others (except for the previewed prototypes, such as the Cotter PSC-2 and the Rappaport PRE-3). We therefore proclaim it our top choice with some hesitation and trepidation, but we have no alternative. The Precision Fidelity C4 is simply the best, meaning the sonically most accurate and beautiful, production preamplifier known to us as we go to press.

This may very well be the last hurrah of vacuum-tube technology in preamplifier design, in the sense that the Audio Research SP-6 was announced to be but isn't. The Precision Fidelity C4 uses considerably more original circuitry and pushes the inherent audio amplification capabilities of dual triodes one step further. It has stupendous headroom; screaming sopranos, singly and massed, traced by the fastest moving-coil cartridge and fed to the phono input through the Cotter transformer, are reproduced without the slightest sense of strain and total clarity. The entire sonic presentation can only be described as wide open from top to bottom. Sweet and smooth, yes, but also minutely detailed, precisely focused, and clean, clean, clean. In other words, it sounds real. If we have any residual criticism at all, it concerns the lower midrange, which some auditioners felt was a wee bit mushier than on the best solid-state units. It's a quibble, though, not a serious objection, in view of the absolutely convincing overall sound of the C4. If you've ever heard the Audio Research SP-6, imagine its good qualities increased and its shortcomings taken away; that's basically the sound of the Precision Fidelity C4. (But only after a good many hours of warm-up; this is definitely another unit that shouldn't be listened to cold.)

Our laboratory tests were of necessity cut shorter than usual to get this review into print; but we can at least report decent RIAA equalization (±0.35 dB, 20 Hz to 43 kHz, but still with the typical saddle-and-hump error curve indicating the usual incorrect topology) and no obvious anomalies at first blush. The construction and parts seem truly excellent, and there's a full complement of controls and switches on a well-organized front panel. (No tone controls, however.)

We shall have more to say about this exciting new product as we get to know it better; meanwhile we're definitely leaving it in our reference system.

PS II

PS Audio, 1529-C Stowell Center, Santa Maria, CA 93454. PS II Phono Preamplifier, $119.95. One-year warranty. Tested #0746, on loan from manufacturer.

This is a self-powered, RIAA-equalized phono stage, designed to be plugged into the "aux" input of a regular preamp/control unit. PS Audio advertises it as "the world's best phono stage," guaranteed to improve even the Audio Research or Mark Levinson preamps. We find that to be a bit over the line into taurine territory, but we must admit that for $120 the unit represents remarkable value. It *is* a high-fidelity preamplifier.

The sound of the PS II is somewhat hard and edgy, but no more so than that of a lot of solid-state preamps that are claimed to be SOTA and cost incomparably more. We suspect that neither PS Audio nor their clientele uses the PS II with the best MC cartridges and transformers as we did, so they probably don't know what it sounds like when zapped with accurately traced and transmitted high-frequency transients at high amplitude. It doesn't really sound pretty, not even comfortable, and some asymmetrical distortion we observed on preequalized square waves in the 10 to 20 kHz region may or may not be a good reason why. What the unit sounds like with inaccurate cartridges we really don't care.

One thing the PS II does very well is RIAA equalization. The curve is right on the button. It turns out that the EQ network is passive, just as in the Hegeman, Cotter and latest Rappaport phono stages. That's very good company, but it doesn't quite rub off on this sassy little product, which we can recommend only on a sound-per-dollar basis to budgeteers.

Rappaport PRE-2

A.S. Rappaport Co., Inc., Box 52, 530 Main Street, Armonk, NY 10504. Model PRE-2 Stereo Preamplifier, $520. Three-year warranty; manufacturer pays all freight. Tested #1556 02, on loan from manufacturer.

The PRE-2 is the minimal Rappaport preamp, incorporating the same circuitry as the PRE-1 and PRE-1A but without tone controls. The power supply is internal, as in the PRE-1. Since we've already written a great deal about its predecessors, we can dispose of the PRE-2 fairly quickly.

Improvements in production engineering and quality control, plus a more directly wired signal path than in the PRE-1, actually make the PRE-2 a somewhat better-sounding unit than our previous Rappaport samples. It still has the same RIAA equalization error (-0.7 dB at 20 Hz, midbass OK, +0.6 dB from 5 to 10 kHz) and it still doesn't sound as clear, open and accurate to our ears as the latest factory-updated Mark Levinson ML-1 or the Hegeman HPR/CU or even the comparably priced Apt/Holman, although it's very close to the latter (but both *must* be turned on for a day or two for a valid comparison). We also noticed that when we changed our reference cartridge from the Sleeping Beauty Shibata to the FR-1 Mk 3F, the PRE-2 dropped slightly in the pecking order as a result of some sonic strain its phono stage developed under the assault of those fast transients.

Everything considered, we rate the Rappaport PRE-2 among the top half dozen or so production preamplifiers today, regardless of price, which isn't bad at all considering that the far superior PRE-3 is just around the corner.

Rappaport PRE-3
(preview)

A. S. Rappaport Co., Inc., Box 52, 530 Main Street, Armonk, NY 10504. Model PRE-3 Stereo Preamplifier (with external power supply), $1300. Three-year warranty; manufacturer pays all freight. Auditioned manufacturer's preproduction prototype.

We heard this under almost exactly the same conditions as we did the Cotter PSC-2. A not quite perfect prototype was lent to us just long enough to listen to but not to put through our usual test procedures. Unfortunately it wasn't the same day we had the PSC-2; it would have been an interesting comparison. The new Rappaport, like the new Cotter, operates in the current mode and uses no feedback. The phono equalization is passive, just as in the Cotter. So the smartest old-timer and the brightest young whippersnapper in audio have their heads in the same place when it comes to state-of-the-art preamp design. Except that the Rappaport is a complete preamp/control unit, with all the usual functions except tone controls.

The PRE-3 also gave us the impression of a completely clean and open top, outclassing all present production preamps in that respect with the exception of the Precision Fidelity C4. It's midrange was quite possibly even clearer than that of the C4. In other words, it will be a SOTA contender for sure.

The greatest shortcoming of the PRE-3 is a relatively noisy phono stage, not nearly as low in hiss as that of the C4 or the Cotter PSC-2. We're told that the production version will be somewhat quieter; meanwhile it's safe to predict that when all the new stuff is out and the dust settles, the PRE-3 will either win, place or show.

Series 20 Model C-21

Series 20 (a division of Pioneer Electronic Corp.), 75 Oxford Drive, Moonachie, NJ 07074. Model C-21 Stereo Preamplifier, $390. Two-year warranty. Tested #YH3600005M, on loan from manufacturer.

Pioneer's first preamp effort under their new audiophile-oriented pseudonym is a respectable one; the C-21 looks good and is extremely well built for this price range—and it even sounds decent. We can't award it any special laurels on account of a somewhat edgy and at the same time slightly nasal quality when pushed, but we've heard a lot worse for a lot more money. The flaws aren't really obtrusive; with just a wee bit more ease and plush in the sound, this could be tough competition.

We believe that the problems are in the phono stage, since the high-level stage by itself sounds surprisingly clean even when judged against all comers. On the test bench the C-21 appears to be ridiculously perfect; the RIAA equalization is actually more accurate than in the DB-1A, which tries to make a special bid for fame on that count. We could see no anomalies that would explain that touch of

sonic aggression; it may be a fairly subtle feedback-related phenomenon.

One thing we liked especially about the C-21 was the 32-position attenuator-type volume control. It's the sexiest one we've ever seen on medium-priced equipment. All the other controls are also step-type and feel great. "They order these things better in Japan." Wish they would also listen more carefully.

Technics SH-901 Equalizer

Technics by Panasonic, Panasonic Company, Division of Matsushita Electric Corporation of America, 1 Panasonic Way, Seacaucus, NJ 07094. SH-9010 Universal Frequency Equalizer, $500. Two-year warranty. Tested #SGP91B, on loan from manufacturer.

Speaking of the Japanese gulf between manufacturing wizardry and listening criteria, here's a classic case. We don't generally set much store by variable equalizers because the time-domain errors they inevitably introduce are usually more bothersome than the frequency-domain errors they're supposed to correct. But this 5-band graphic/parametric equalizer, offering variable amplitude, variable center frequency *and* variable Q on each band, has so much mouth-watering technology crammed into a $500 box that we just had to play with it. So we inserted it right after the preamp in our reference system and listened.

We should have known better. There's a bypass switch on the unit, labeled "equalizer in/out." Aha, we thought, we can find out right at the start whether all that mind-boggling circuitry introduces any sonic coloration of its own. We set everything dead flat on the equalizer and operated the bypass switch. No difference whatsoever either way. Must be a perfectly neutral and transparent device, right? But wait a minute, it didn't *sound* right either way. Everything was a little closed-down and unfocused. We pulled the wall plug of the SH-9010 with bypass switch in the "out" position. You guessed it—the sound stopped. It wasn't a straight-wire bypass after all; there were energized circuit stages in the signal path at all times. We removed the SH-9010, reconnected the preamp directly, and there was our familiar reference sound again, open and beautifully focused.

It's not nice to fool audiophiles that way, Panasonic, and it will be a cold day in July when we can be persuaded to try a commercially available variable equalizer again. That doesn't alter our admiration for the sheer technical ingenuity and production savvy that went into this misdirected product.

Recommendations

Keep in mind that the two previewed prototype units were excluded from consideration for this list, pending full tests of the eventual production models; both, however, were sufficiently promising to be at least potential candidates for top choice in the next issue.

Best preamplifier so far, regardless of price: Precision Fidelity C4 (based on somewhat limited testing—see review above and future updates).

Best preamplifier per dollar: Apt/Holman (for absolute ranking, see review above).

Best way to play moving-coil cartridges: Cotter MK-2 transformer (electrically identical and physically superior to Verion MK-1, which is no longer made).

Best interface between preamplifier and power amplifier: Cotter NFB-2.

Preamplifier Summaries and Updates

All of the following preamplifiers were reviewed in Volume 1, Numbers 1, 2 or 5. Units reviewed that are of no current interest and haven't been replaced by an improved model are not listed.

Ace 3100

Ace Audio Co., 532 Fifth Street, East Northport, NY 11731. Model 3100 Stereo Preamplifier, $325 (with external power supply).

Very open, focused and detailed midrange; sizzly, nasty, almost unlistenable highs. Pity.

AGI Model 511A

Audio General, Inc., 1631 Easton Road, Willow Grove, PA 19090. Model 511A Stereo Preamplifier, $465.

Beautiful construction for this price range; somewhat edgy and irritating sound on dynamic material, combined with a subjective effect of thinness. Not SOTA.

Audionics BT-2

Audionics, Inc., Suite 160, 10950 SW 5th, Beaverton, OR 97005. BT-2 Preamplifier, $449 (with handles on front panel, $459).

Best preamplifier per dollar the last time around; nosed out by the Apt/Holman in our latest tests. Open, smooth, focused, lacking only the ultimate immediacy and super detail. A new modification, to be out soon, is claimed to be considerably superior.

Audio Research SP-3A-1

Audio Research Corporation, 2843 26th Avenue South, Minneapolis, MN 55406. Model SP-3A-1 vacuum-tube preamplifier/control: no longer available in the version reviewed.

If you own an SP-3, SP-3A or SP-3A-1, you can have it modified by Audio Research "to upgrade it to the SP-6 level" (it says here). The cost is $470. The mod will presumably give you the SP-6 kind of sound, plus tone controls and tape copy features. The SP-3A-1 we originally tested had much more aggressive and less natural highs than the SP-6.

Audio Research SP-4

Audio Research Corporation, 2843 26th Avenue South, Minneapolis MN 55406. Model SP-4 solid-state preamplifier: no longer available in the version reviewed.

The original SP-4 we tested sounded open, clear, but hard and sibilant. The bass was somewhat deficient. Now there's a new SP-4A at $975, which we haven't tested. The SP-5, at $595, appears to be the same thing without tone controls.

Bravura

Audio Arts, 4208 Brunswick Avenue North, Minneapolis, MN 55422. Bravura Stereo Preamplifier, $495.

An astonishingly wrongheaded design, full of little cultist quirks. Sounds like a transient filter; no sparkle, no life.

CM 300

Audio International, Inc., 3 Cole Place, Danbury, CT 06810. CM 300 Stereo Control Center, $549.

Forget it; not in the same class with any number of more recent units selling at lower prices.

Cotter MK-2

Mitchell A. Cotter Co., Inc., 35 Beechwood Avenue, Mount Vernon, NY 10553. Moving-Coil Pickup Transformer MK-2, $425.

The laws of physics strongly suggest that a textbook-perfect transformer will outperform a textbook-perfect active device (pre-preamp or head amp) when it comes to interfacing a low-impedance moving-coil pickup with subsequent stages of amplification. The Cotter MK-2 transformer begins to approach the aurally perceptible thresholds of such textbook perfection; certainly no active device known to us is as quiet or as close to a straight wire in its sonic character. Mitch Cotter's original Verion MK-1 transformer was electrically identical but is no longer made; the new MK-2 incorporates some minor improvements in physical construction, including better plugs.

Dayton Wright SPS Mk 3

Dayton Wright Associates Limited, 350 Weber Street North, Waterloo, Ont., Canada N2J 4E3. SPS Mk 3 Professional Preamplifier, $555.

Sounded reasonably smooth and detailed, though a bit closed down, when we tested it; however, this company has changed hands since—so who knows? The RIAA equalization was quite inaccurate on our test sample.

Dynaco PAT-5

Dynaco, Inc., Coles Road & Camden Avenue or PO Box 88, Blackwood, NJ 08012. PAT-5 Preamplifier: no longer available in the version reviewed.

The current version is the PAT-5 Bi-FET at $299 (kit only); the original version we tested sounded absolutely horrible. Variability of parts has been the bugaboo of this line.

GAS Thaedra, Thoebe, Thalia

The Great American Sound Co., Inc., 20940 Lassen Street, Chatsworth, CA 91311. 'Thaedra' Servo-Loop Preamplifier: no longer available in the version reviewed. 'Thoebe' Servo-Loop Preamplifier, $599. 'Thalia' Servo-Loop Preamplifier, $339.

Thaedra II, at $1049, replaces the original version we tested. Thoebe (same thing minus MC head amp) remains as before; so does Thalia. We're not too fond of the design philosophy and listening criteria of this company, although we see some recent evidence that they're having second thoughts. We don't consider any one of these preamps to be a good buy at its particular price point; all have a veiled, hazy, smeared-over sound quality indicating serious time-domain problems.

Hafler DH-101

The David Hafler Company, 5817 Roosevelt Avenue, Pennsauken, NJ 08109. Model DH-101 Stereo Preamplifier, $299.95 wired. (In kit form, $199.95.)

After having examined and lived with two additional samples of this preamp, we're ready to concede that the deterioration of our original review sample after prolonged "cooking" on our equipment rack was untypical. These last two samples continued to produce open, spacious, balanced, well-focused sound week after week, with just a slight cutting edge when pushed hard with a superfast cartridge. We really can't think of more than six or seven production preamplifiers, at *any* price, that we'd currently rate superior to the DH-101. At its price, either wired or as a kit, nothing can touch it. We still don't like those 0.01 microfarad bypass capacitors on the AC line; they're a shock hazard and a source of hum. In general, the unit is quite prone to hum in some installations because of its peculiar grounds. Even so, it's an honest and intelligent product, representing good value.

Hegeman HIP Input Probe

Hegeman Audio Products Inc. (Hapi), 176 Linden Avenue, Glen Ridge, NJ 07028. Model HIP Input Probe with HPS power supply. $160.

This is essentially the unequalized input stage of the complete Hegeman preamplifier, made available here on a separate minichassis. It acts as a plug-in interface between the phono cartridge and your present phono input. If the latter is incorrectly designed (e.g. Audio Research SP-4), the Input Probe will effect a definite improvement in sound. Our recommended preamps, on the other hand, don't need it.

Linn Moving Coil Preamp

Audiophile Systems, 5750 Rymark Court, Indianapolis, IN 46250.

Linn/Naim Type PNAG moving coil preamp with Type NAPS power supply, $250.

Not as neutral, transparent and low in noise as the Cotter (formerly Verion) transformer but less veiled and colored than other pre-preamplifiers known to us.

Luxman C-1000, CL-35/III, CL-350

Lux Audio of America, Ltd., 160 Dupont Street, Plainview, NY 11803. Model C-1000 Control Center: no longer available in the version reviewed. Model CL-35/III Vacuum Tube Control Center, $795. Model CL-350 Solid State Control Center: no longer available in the version reviewed.

The sound of the original C-1000 was closed-down and at the same time slightly aggressive; we have no idea what its cheaper replacement (C-1010, $745) sounds like. The CL-35/III, still in the line, is a decent tube preamp but not in a class with our present top choices. The defunct CL-350 appears to have no direct descendant; in its time it sounded hard, nasal and ugly.

Marantz 3600

Superscope, Inc., 20525 Nordhoff Street, Chatsworth, CA 91311. Marantz 3600 Stereo Control Console, $499.95.

Unbearably aggressive highs; forget it.

Mark Levinson ML-1

Mark Levinson Audio Systems, 55 Circular Avenue, Hamden, CT 06514. ML-1 Preamplifier, with plug-in System A, $1850. (Plug-in System D for MC cartridges, $240 extra.)

We still don't know of a solid-state preamplifier in actual production that equals this one in clarity, smoothness, balance, and low noise; the Precision Fidelity C4 and Audio Research SP-6 tube preamps, however, are definitely cleaner, more transparent, more effortlessly natural in sound, though not as quiet. The new current-mode feedbackless preamps (Cotter, Rappaport) will undoubtedly be the future threats to the supremacy of the ML-1 in the solid-state category. Our own sample has undergone three factory overhauls in a year and a half, each time because we suspected a slight lapse in performance; each time it came back sounding considerably better and ranking higher in our comparative tests. The latest update involved replacement of our very early phono input modules and applying shielding to some previously unshielded sections of the switch wiring. Before these changes both the production Hegeman and the Apt/Holman sounded more open and better focused. We can only speculate whether or not all this is typical of other samples in the field.

Paragon Model 12

Paragon Audio, 997 East San Carlos Avenue, San Carlos, CA 94070. Model 12 vacuum-tube preamplifier: no longer available in the version reviewed.

This was the best tube preamp of its time, quite comparable to the top solid-state units and barely nosed out by the then new Mark Levinson ML-1. We haven't tested its successor, the Model 12A ($1045); meanwhile the rumor is that this company has folded. What a shame.

Quad 33

Acoustical Manufacturing Co. Ltd., Huntingdon, Combs. PE18 7DB, England. Quad 33 Control Unit, $295.

Respectable sonic performance and unusually clever variable high filter; the Hafler DH-101, however, offers tighter, better focused sound at the same price.

Rappaport PRE-1 and PRE-1A

A.S. Rappaport Co., Inc., Box 52, 530 Main Street, Armonk, NY 10504. Model PRE-1 Stereo Preamplifier, $620. Model PRE-1A Stereo Preamplifier, $555, with PS-1 Power Supply, $200, and optional MC-1 Moving Coil Phono Stage, $300.

We refer you to the Rappaport PRE-2 review above; the PRE-1 and PRE-1A have tone controls but are otherwise the same preamp. The MC-1 is far too noisy for our taste and its RIAA equalization error is too large for comfort.

Stax SRA-12S

American Audioport, Inc., 1407 North Providence Road, Columbia, MO 65201. Stax SRA-12S integrated preamplifier/headphone amplifier, $500.

We saw this listed some time ago with an RII suffix; we're sure it's still essentially the same unit we tested. We didn't like the preamp section at all; it sounded hard and sizzly on dynamic material. The headphone amplifier section also disappointed us in the long run.

Supex SDT/180

Sumiko Incorporated, PO Box 5046, Berkeley, CA 94705. Supex SDT/180 Step-Up Transformer, latest price NA (was $150).

We prefer transformers to pre-preamps for moving-coil cartridges—but not like this. Rolled-off bass and distorted to boot.

Van Alstine Model One

Van Alstine Audio Systems, Inc., 12217 Riverwood Drive, Burnsville, MN 55337. Model One direct-coupled stereo preamplifier, $600.

Highly touted but far from SOTA. The sound is open and essentially neutral but still a bit grainy, edgy and irritating. The phono stage shows some anomalies on square waves.

Verion MK-1

Susperseded by Cotter MK-2 (see above).

Yamaha C-1 and C-2

Yamaha International Corp., 6600 Orangethorpe Avenue, Buena Park, CA 90620. NS Series C-1 Stereo Preamplifier, $1800. NS Series C-2 Stereo Preamplifier, $650.

The C-1 was an overpriced PR stunt for image building; it's no longer on the market. The sound was smooth but closed-down and lacking in inner detail. The C-2 was (or is, if it's still around) beautifully built for the money, very low in noise, but impossibly sizzly and aggressive on high-frequency transients.

Cartridge/Arm/Turntable Follow-Up: Loose Ends and New Developments

Part III of our series, in which we simplify (without compromise) our lateral and vertical tracking alignment instructions, clear up a few misunderstandings, and talk about some far from negligible new products.

Some of our readers haven't quite recovered from the shock of being told that nearly all tone arm mounting holes are drilled in the wrong place, nearly all headshells are offset at the wrong angle, and nearly all cartridges are mounted in the wrong position within the headshell. That these ridiculous errors should be permanently frozen in the design specs of tone arms and turntable/arm systems, as well as in tone arm manufacturers' mounting instructions, is something the average audiophile finds hard to swallow. Add to that the incorrect vertical tracking angle (VTA) designed into the majority of cartridges, and we begin to get reactions from "I don't believe it" to "I give up."

Well, you had better believe it and you had better not give up, otherwise your $10,000 stereo system is a joke. No system, no matter how sophisticated, can correct the time-dispersive distortions introduced right at the stylus tip of an incorrectly aligned cartridge. And those distortions are readily audible, assorted Pollyannas and vested interests to the contrary notwithstanding.

For the benefit of our new subscribers and of all those who found our original presentation of the subject (Volume 1, Numbers 1, 4 and 5) a bit more than they had bargained for, we want to restate our basic message as simply and inescapably as we can, at the same time making the alignment instructions somewhat more obvious and palatable.

The playback stylus *must* mimic the cutter stylus.

As you undoubtedly know, a stereo groove is cut both laterally and vertically. The lateral motion of the cutter stylus, when the original lacquer master is made, always takes place along a radius of the record, i.e., the line passing through the stylus tip and the turntable spindle. That's inherent in the geometry of the cutter mechanism. The vertical motion of the cutter stylus is *not* perpendicular to the record, as you might think (and as would be simplest),

but occurs at an angle that deviates from the perpendicular by 15 to 18.5 degrees in modern cutting practice. Now, the only way you can get the identical waveform *out of* the terminals of the playback cartridge as went *into* the terminals of the cutter head is to duplicate this lateral and vertical motion, without any angular errors, at the tip of the playback stylus. That's all there is to it.

If the lateral motion of the playback stylus is *not* exactly along a radius (lateral tracking error) and/or if its vertical motion is *not* inclined at exactly the original cutting angle (vertical tracking error), the result is not only simple harmonic and IM distortion, as has been popularly assumed, but also frequency intermodulation (FIM) and frequency cross-modulation (FXM) distortion, which are time-dispersive and therefore much more audible and disturbing. The mathematical proof of this is 37 years old in the case of lateral tracking error and at least 15 years old for vertical tracking error (see the references in our original articles), so we're getting just a little tired of arguing about the inarguable with resisters of Mother Nature who haven't done their homework. (Some of them in surprisingly high places, we might add.)

The point is that, when your reference signal is riddled with FIM and FXM distortion, you can't tell how good or bad the components are that you're listening to. Therefore, all subjective evaluations of audio equipment where phonograph records are the program source must be considered highly suspect unless the cartridge has been aligned within an inch (or rather 0.005 inch) of its life. And one way to make virtually certain that the cartridge is *misaligned* is to mount it dead straight and trued up in the headshell of a tone arm that in turn is mounted on the turntable according to the manufacturer's instructions (or even *by* the manufacturer). A quick check of your own arm and cartridge against the data presented below will confirm that outrageous statement—unless, of course, you're one of our regulars and have already performed the corrective alignments. Unfortunately, we're the only reviewers to keep harping on this subject, which may be one reason why we sometimes come to different conclusions than our colleagues, especially about cartridges and preamps. (Components such as speakers, headphones and power amps can also be evaluated with tapes, although we don't know of too many reviewers who use 30-IPS master tapes like ours, either.)

The positive aspect of the matter is that a correctly located stylus will reveal unsuspected treasures in your record collection; suddenly you'll discover that a large percentage of 12-inch LP records, both old and new, sound quite excellent when the information in their grooves is extracted unaltered. In fact, the overall sonic improvement after a typical phono setup is brought into precise alignment is generally greater than what audiophiles expect, and get, when they switch from one *good* cartridge or preamplifier to another. Therefore, our final word of advice is: align before you switch. (You've just saved yourself the equivalent of a lifetime subscription to **The Audio Critic**.)

The basics of
lateral tracking alignment.

There are only two kinds of tone arms capable of error-free lateral tracking and requiring no lateral alignment computation. One is the theoretically ideal straight-line tracking kind, exemplified by the Rabco variants and the Bang & Olufsen. Unfortunately, we've never run across one that was the equal of the best conventional arms in its solution to more mundane design problems, such as bearing play and arm tube resonances. (Of course, we haven't seen every one of the basement workshop mods.) The other is the pantograph-type arm, of which the Garrard tangent-tracking changer arm is the best-known current example. This somewhat awkward format is beset by its own peculiar demons (although we've seen a very promising execution by Win Laboratories, still in prototype form) and, unlike the straight-line tracking arms, still needs antiskating bias. It appears that the classic pivoted arm is here to stay for a while, as it has proven to be the most readily perfectible format, except for its inherent lateral tracking error—which is of course what we're trying to optimize here.

It's obvious that a rigid pivoted arm must swing in an arc and therefore can't possibly track radially. What's less obvious is the precise relationship between the resulting tracking error and the corrective offset/overhang geometry of typical arms. A prevalent mistake is to assume that it's the tracking error that must be minimized. Actually, it's the tracking *distortion*, which happens to be directly proportional

to the tracking error but inversely proportional to the radial distance of the groove from the spindle. Consequently what must be minimized is the *ratio* of the tracking error to this radial distance. The correct way to formulate the basic mathematical question about optimum lateral tracking geometry is therefore the following: with a tone arm of given effective length, and over a total recorded area of given maximum and minimum radii, what combination of offset angle and overhang will yield the smallest possible peak values of the ratio of tracking error to groove radius? Not a seventh-grade problem in geometry, that one, although any competent mathematician could give you the correct solution. No one bothered until 1941, when H.G. Baerwald did the job once and for all. Our table of alignments is based entirely on his definitive work, which should have eliminated forever (among other things) the untutored practice of jockeying for zero tracking error at the innermost groove, a la SME. Correct alignment results in two zero-error points, the first about one third of the way into the recorded area, the second close to but still a small distance away from the innermost groove. And with optimum offset angle and overhang, these zero-error points are *fixed*, regardless of arm length, as long as the maximum and minimum radii of the recorded area are specified. (For exact numerical values, see table.)

The important thing to remember is that correct tone arm geometry is *not* a matter of opinion; for any given set of conditions there exists only one optimum solution, and all others are wrong. Unfortunately, the message hasn't reached the vast majority of tone arm designers yet, nor equipment reviewers for that matter. The next arm or turntable/arm combination you buy is virtually certain to have incorrect geometry and/or mounting instructions, especially if what you're after is optimized playback of 12-inch LP records. (Some designers depart from optimum LP geometry to accommodate 45-RPM doughnut singles. Yechh.) On the sunny side, it must be emphasized that very few arms are so far off in their basic dimensions that minor corrective surgery can't bring them in line with our table of optimum alignments. It's a fussy, unforgiving, time-consuming job, however, which we can't confidently recommend as a "first project" for the total novice even on the basis of the somewhat simplified (or at least more deliberately spoonfed) instructions that follow. Above all, you must be thoroughly comfortable with elementary geometrical concepts such as parallel, perpendicular, right angle, zero degrees, radius, axis, etc., before attempting the alignments. As we've discovered, not all owners of $10,000 stereo systems meet that requirement. (We trust that all high-end dealers do; they're not doing their job if they won't help you with this sort of thing.)

The procedure itself.

You begin by installing the cartridge in the tone arm. If the headshell has no slots in it, only a pair of screw holes, you're already in trouble; you may have to enlarge the holes later. Never mind for the moment; just put in the screws and connect the cartridge leads. If there are slots in the headshell, don't push the cartridge all the way forward or backward; leave some room in the slots for making an eventual adjustment either way. Now tighten the screws just enough to seat the cartridge firmly, but not so much that you can't move it with a little pressure.

You're now ready to measure the effective length of the tone arm. This is defined as the perpendicular distance from the stylus tip to the lateral swing axis and must therefore be measured in a plane parallel to the record surface. The most convenient plane is generally (but not necessarily, in the case of oddball arms) the one in which the top of the headshell and the top of the arm tube lie. Try to locate the position of the stylus tip as seen from the top of the headshell. You may even want to mark a dot on the headshell with a fine-tipped felt pen. (Sometimes, though, the stylus will stick out in front of the headshell. Then you'll just have to locate it with respect to the top of the cartridge itself.) Next, locate the exact axis around which the arm swings laterally. This will usually coincide with the central axis of the arm pillar, but (again) some arms can fool you visually. The center point of the top bearing or pivot will nearly always be a good visual reference. Once you have these two points unequivocally located, measure the distance between them. Try to be accurate within half a millimeter or so, but don't agonize over this measurement, as it happens to be the least critical in the entire alignment procedure.

Now look at the table of alignments. Find the optimum overhang corresponding to the effective arm length you've just measured. If

Metric Table of Optimum Overhang and Offset Angle Alignments for Pivoted Tone Arms

Optimized for a 30-cm LP record with a recorded area between the IEC Standard maximum and minimum radii of 146.05 and 60.325 mm. Zero tracking error in all cases at radii of 120.9 mm and 66.0 mm. Optimum offset angles are specified for reference purposes only and are not involved in the recommended alignment technique. Please note that this is a simplified table, with decimal places rounded off beyond the highest expected measurement accuracy without specialized instruments. Also note that the product of the effective arm length and the sine of the optimum offset angle is a constant (93.4 mm). This corresponds to the length of the perpendicular from the lateral pivot point to the rearward extension of the long axis of the cartridge. For conversion to inches, use 1 mm = 0.03937 in or 1 in = 25.4 mm.

Effective Arm Length (mm)	Optimum Overhang (mm)	Optimum Offset Angle (°)
200	21.1	27.9
201	20.9	27.7
202	20.8	27.6
203	20.7	27.4
204	20.6	27.3
205	20.5	27.1
206	20.4	27.0
207	20.3	26.8
208	20.2	26.7
209	20.0	26.6
210	19.9	26.4
211	19.8	26.3
212	19.7	26.2
213	19.6	26.0
214	19.5	25.9
215	19.4	25.8
216	19.3	25.6
217	19.2	25.5
218	19.1	25.4
219	19.0	25.3
220	18.9	25.1
221	18.9	25.0
222	18.8	24.9
223	18.7	24.8
224	18.6	24.7
225	18.5	24.5
226	18.4	24.4
227	18.3	24.3
228	18.2	24.2
229	18.1	24.1
230	18.1	24.0
231	18.0	23.9
232	17.9	23.8
233	17.8	23.6
234	17.7	23.5
235	17.6	23.4
236	17.6	23.3
237	17.5	23.2
238	17.4	23.1
239	17.3	23.1
240	17.2	22.9
241	17.2	22.8
242	17.1	22.7
243	17.0	22.6
244	16.9	22.5
245	16.9	22.4
246	16.8	22.3
247	16.7	22.2
248	16.6	22.1
249	16.6	22.0
250	16.5	21.9
251	16.4	21.9
252	16.4	21.8
253	16.3	21.7
254	16.2	21.6
255	16.2	21.5
256	16.1	21.4
257	16.0	21.3
258	16.0	21.2
259	15.9	21.1
260	15.8	21.1
261	15.8	21.0
262	15.7	20.9
263	15.6	20.8
264	15.6	20.7
265	15.5	20.6
266	15.4	20.6
267	15.4	20.5
268	15.3	20.4
269	15.3	20.3
270	15.2	20.2
271	15.1	20.2
272	15.1	20.1
273	15.0	20.0
274	15.0	19.9
275	14.9	19.9

the arm isn't mounted yet, the correct distance of the mounting hole from the turntable spindle is obviously the effective arm length minus the optimum overhang. Drill it exactly there, regardless of where the arm manufacturer tells you to drill it. If the arm is already mounted in a hole drilled at an incorrect distance, your last hope is that the hole is large enough to allow some play or that the leeway you left in the headshell slots will be enough to correct the situation. In some cases the arm may have to be removed and a new hole drilled. (Please blame the perpetrator of the goof, not the bearer of the bad news.)

Assuming that the arm is mounted correctly, or almost correctly, you're ready to align the overhang. This must be done with the stylus tip, the turntable spindle and the lateral pivot center all in one straight line. If you can't swing the cartridge all the way over the spindle, loosen the arm pillar and twist it until you can. The overhang should be measured with a short, narrow and very accurate machinist's scale or ruler; if you measure the distance from the stylus tip to the perimeter of the spindle and then add the radius of the spindle (which is always 3.6 mm), you'll have no trouble getting an accurate overhang reading. Then you can gently prod the half-tightened cartridge into place so that you obtain the optimum overhang. But don't tighten the screws all the way yet.

Now comes the moment of truth. You must check the lateral tracking error at the two universal null points referred to above and set the error to zero, without changing the optimum overhang you've just obtained. For this you'll need an alignment protractor, which you can easily fabricate for yourself from an ordinary file card. Simply mark off three points on one of the printed lines anywhere near the middle of the card. From left to right, the second point should be 66.0 mm from the first and the third point 120.9 mm from the first (*not* from the second). Then punch a spindle hole of 7.2 mm diameter through the first point. If you wish, draw two perpendiculars to the printed line, intersecting it at the second and the third point; some people don't find this necessary. Slip this protractor over the turntable spindle and very gently lower the stylus over the 120.9 mm point. The best thing is to poise the diamond just a hairsbreadth above the protractor by means of the cueing mechanism, so as to prevent possible damage through actual contact and slippage. Now, determine whether the stylus bar is dead perpendicular to the printed line at the 120.9 mm point or, alternately, whether the front edge of the cartridge is dead parallel to the printed line when the stylus tip is on the 120.9 mm point. (The latter determination is possible only with perfectly rectangular cartridges, such as the Denon DL-103 series.) This is where most people begin to have trouble with the alignment procedure, since there are as many nagging little problems that arise as there are different cartridge bodies and headshell configurations. We have no easy answers; various alignment tools have been suggested, none of which is commercially available; a small, thin mirror, scored with "cross hairs," is a possibility, but of course it must be accurately located. The best tool is a complete understanding of the basic geometry of the situation; the visual references will then suggest themselves.

If the lateral tracking error isn't zero at the 120.9 mm point, twist the cartridge in the headshell (i.e., point the stylus further inboard or outboard) until the error disappears. If you did this exactly right, the error will also be zero at the 66.0 mm point. Check carefully back and forth between the two points, making sure at the same time that you haven't changed the correct overhang in the process. If the cartridge can't be twisted in the headshell, you may have to switch to thinner mounting screws or, in extreme cases, enlarge the screw holes in the headshell with a file or drill. Be prepared to go through several cycles of alignment (optimum overhang vs. effective arm length, null points, twisting, etc.) until everything is perfectly trimmed in. That's when you finally tighten the screws all the way—but not so much that you shift the cartridge and undo all you've done.

And that's it; you've now optimized the lateral tracking geometry.

Antiskating bias adjustment.

As a necessary consequence of offset arm geometry, the friction of the moving groove against the stylus exerts a pulling force that is not in a straight line with the holdback force opposing it. The net result is an inward (i.e., spindle-ward) skating force, which must be canceled out in order to maintain equal forces on both groove walls and also to prevent tracking error from creeping right back in again. The

next step in the alignments, therefore, is the application of correct antiskating bias.

A lot of incorrect information has been circulated on this subject. One of the recurrent assertions is that antiskating bias is impossible to set accurately, since the skating force varies with the location of the stylus on its way across the record and with the modulation level of the groove. That may very well be the case when either the lateral tracking geometry or the vertical tracking force is totally out of whack, but most emphatically not when they are properly trimmed in. With the tracking angle reasonably constant and the stylus firmly seated in the groove at all times, the frictional bias on the stylus, and therefore the skating force, will undergo no appreciable change from outer groove to inner groove and from quiet to loud passages, so that it can be effectively neutralized with an equal and opposite bias. The very alignment procedure that follows proves that point directly *in situ*.

First, set the vertical tracking force to the *highest* figure that's still within the cartridge manufacturer's recommendations. (Don't worry; when everything is properly aligned, your records are perfectly safe with the higher VTF and distortion is much lower.) Next, set the antiskating bias on the arm to correspond to the VTF you've just selected. (Who knows, the arm may even be calibrated accurately.) Now put a record with a quiet opening passage (i.e., barely visible wiggles in opening grooves) on the turntable and play that passage while looking at the cartridge and stylus from the front. A hand-held magnifier of the right size can be helpful here. Since the side-to-side excursions of the stylus will be minimal, it should appear perfectly centered with correct antiskating bias. To check perfect centering, raise the cartridge a few millimeters above the record and then lower it again. There should be absolutely no visible difference in centering either way. If there's the *slightest* sideways snap of the stylus as you raise it, there's either too little or too much antiskating bias applied and you must adjust it. When you're convinced that everything is right on the button, try another quiet passage further in on the record. Lo and behold, the stylus remains perfectly centered and no further adjustment is required. On heavily recorded passages the centering is more difficult to verify by eye but will remain correct if you did the quiet-groove adjustment accurately.

Vertical tracking angle alignment.

Even after the lateral tracking geometry, vertical tracking force and antiskating bias are totally optimized, you ain't home free yet. The vertical tracking angle still needs to be trimmed in. What's more, it needs to be trimmed in over and over, whenever you change from one particular make of records to another, and even within the same make from older to more recent releases. Again, don't cut off the head of the messenger who brings the bad news. We can't help it if the record industry has no VTA standard and every company is cutting records with their own version of the "best" angle. All we can tell you is that you *must* compensate for these VTA variations if you want to enjoy the sound of a correctly aligned phono system; in fact, without proper VTA alignment, the benefit of all the preceding alignments will be largely lost, at least in stereo.

The issue, then, isn't whether or not the VTA needs to be realigned with each record but how to do it with the least fuss and bother. Fidelity Research (FR) has an excellent solution to the problem (see review below); their knurled-knob adjustment is almost as easy to set by ear as a tone control. FR arms that incorporate this feature are mind-bogglingly expensive, though, so that owners of plebeian Graces, Black Widows, Series 20's and the like will have to go through the following less convenient procedure.

Get a copy of one of the Mark Levinson Acoustic Recording Series albums. (The reason why we specify the brand is that MLAR records appear to be cut with a larger VTA than any other make we've run across. If you set your arm pillar height for the largest VTA you're likely to encounter, you'll need to mess only with the front end of the arm from there on.) Listen very carefully to this record while you vary the height adjustment of the arm pillar in the tiniest possible increments. Try to obtain the most incisive, most clearly etched highs short of actual edginess and the most transparent, least gargly or hooty midrange. Generally speaking, you'll hear a wiry or edgy quality creep in as you go too high with the pillar and a somewhat muffled, gagged quality as you go too low; these aural guidelines are valid, however, only if you're already in the ball park, approaching the correct setting. A setting that isn't even close to right could sound like anything at all—except right. Some cartridges are

designed with a VTA so large that it's impossible to set the pillar low enough for correct compensation. Shimming the cartridge behind the mounting screws so that the heel of the cartridge case almost touches the record is a desperate last measure that also fails in extreme cases. If you stick with our recommended moving-coil cartridges you won't run into this difficulty.

When you're convinced that the MLAR record sounds as clean and focused as it possibly can in your system, lock the arm pillar permanently with the height-adjustment screw or screws. Then round up the following paraphernalia: (1) the thinnest record you can find (one of the early RCA 'Dynaflex' jobs will do nicely); (2) a record of normal thickness; (3) the thickest record you can find (a really ancient mono LP ought to fill the bill); (4) a large cardboard strobe disc, or anything else that will fit on the turntable spindle and is a lot thinner than even the thinnest record. By using these, either singly or in combination, as shims under the record you're playing, you can generally achieve proper vertical tracking geometry for the range of VTA's encountered in modern records. Go through the same procedure and note on the jacket what kind of shimming each record sounds best with. Admittedly, a record under another record doesn't constitute the world's most stable and best-damped turntable mat. It's the lesser evil, though, compared to the wrong VTA. Our ears tell us so. Speaking of mats, you may have to remove yours for the initial arm height adjustment, otherwise you'll run out of vertical space with certain arms and/or spindles as you keep shimming. But then you can insert the mat as one of the principal shims for in-between VTA's. Be flexible and experiment freely; you've got nothing to lose but FIM and FXM distortion. Above all, don't check whether the cartridge or the arm tube is parallel to the record, the way it's illustrated in the instruction manual. It doesn't mean a damn thing.

By the way, the one alignment that all the instruction manuals insist on is by far the least important. This is the stylus azimuth alignment, making sure that the diamond shank is perpendicular to the record when viewed from the front. We aren't telling you to ignore this obvious requirement, but rest assured that, say, a 1° error in azimuth will degrade the signal consideraby less than a similar error in lateral or vertical tracking alignment. Furthermore, if the right angles in the construction of the turntable, arm and cartridge are held reasonably close to 90°, there should be no need to worry about the azimuth to begin with. We've never had to fuss with it in the kind of equipment we deal with.

About our latest tests and reviews.

We still don't have an established, sequential laboratory test procedure for phono systems, such as we have evolved for speakers. We never had much faith in standard test records, except for identifying gross deficiencies; accelerometer measurements hold some promise, but we're just beginning to set up instrumentation to see if the results correlate with what we hear. Repeatable tests for mechanical and airborne feedback in turntables and arms are still in the earliest stages of development in the laboratories of the few technologists who fully appreciate this decisive aspect of design; we're in the process of exploring the problem but have no quantified data to report yet.

Thus the reports that follow are based on purely qualitative technical criteria plus extensive listening tests. We'd like to be further along in our laboratory test program; on the other hand, we haven't seen any test or tests from other sources in which the obviously best-sounding cartridges, for example, yield the obviously best measurements. We feel that we can at least distinguish between important and unimportant design characteristics, which is more than what we see in typical equipment reviews; and when it comes to listening, we have speakers and electronics of considerable resolving power to show up the real differences between the units under test. (For a detailed description, see the article on reference systems in this issue.)

ADC LMF-1

Audio Dynamics Corp., Pickett District Road, New Milford, CT 06776. LMF-1 low-mass carbon-fiber tone arm (with integrated headshell), $205. Tested sample on loan from owner.

This Japanese-made arm is correctly conceived in many respects but is disqualified from audio-purist status by that old bugaboo, wobbly bearings. As we've said before, this will invariably result in subtle time modulations of the signal to which the ear is extraordinarily sensitive. Tone arm bearings must never be allowed to have more than one degree of freedom; we wish every tone arm designer could have a Breuer Dynamic in his hands just once and feel those Swiss bearings.

In addition, the offset angle of the LMF-1 is too small for 12-inch LP records, and the overhang specified in the mounting instructions is also too small. Thus, even though it doesn't suffer from incurable diseases, we can't recommend this arm in its current version.

Cotter B-1

Mitchell A. Cotter Co., Inc., 35 Beechwood Avenue, Mount Vernon, NY 10553. Turntable Base B-1, approx. $1300 (including dealer's charge for assembly and alignment but not including turntable or tone arm). Tested samples owned by The Audio Critic.

Mitch Cotter, whom we sometimes refer to as The Wizard of Oz ("because of the wonderful things he does" and other interesting similarities), is now making his highly specialized audio products under his own name instead of Verion's, for various legal reasons that need not concern us here. So start getting used to audio-purist invocations of the Cotter rather than the Verion pickup transformer, the Cotter triaxial cables, etc., and now the monstrous and marvelous Cotter turntable base.

The B-1 is typical of this man's search for final solutions; it's the sort of thing that disposes of the problem in toto and won't have to be done again, except perhaps to make the product less prohibitive in price and cosmetically more appealing. The problem solved by the B-1 is the dirty little secret of all commercial turntables, including the best (even such as the Linn-Sondek LP12 and the Thorens TD 126): they're much too active acoustically. In a room filled with music at a level approaching live listening conditions, mechanical and airborne feedback through the turntable will generate signals in the cartridge that are only a little more than 20 dB below the program level under the most favorable conditions, with the Linn or Thorens type of suspension. Under worst-case conditions, using large woofers and turntables with marginal or no suspension (a la Japanese direct drive), the spurious signals may be as little as 15 or even 10 dB down and in some cases may punch right through the program level. All this without necessarily creating actual oscillation (feedback howl). Needless to say, we're talking about bass and lower-midrange frequencies, not anything over 500 Hz or so. But don't those fantastic rumble figures, obtained in silent laboratories, seem rather meaningless under the circumstances?

We estimate that the Cotter B-1 exceeds the typical isolation figures cited above by at least another 40 dB. The difference is phenomenal; the turntable survey in our next issue should include more precise figures but for the moment let's just say that the B-1 clarifies melodic bass and increases midrange transparency in comparison with *any* other turntable mounting system to a degree we weren't prepared for. No hairsplitting A-B-ing is required; you don't want to switch back to A after the B-1.

The main structure in the B-1 is a 23" by 17½" by 1⅛" thick plate made of laminations of steel and a special energy-absorbing plastic material. It appears to be the acoustically deadest object on the face of the earth; slap it hard and all you hear is the sound of your hand. (We don't advocate this as a scientific test.) Bolted to this base plate are the turntable motor pad and the arm pad, both of them similarly thick plates laminated from aluminum and energy-absorbing plastic. The turntable must be partially disassembled and rewired to mount it on this contraption; it's no job for the novice. The entire system floats on large springs anchored in a heavy Formica-covered frame; the suspension resonance is in the neighborhood of 2 to 3 Hz. With the heavy Plexiglass cover mounted, the total weight is 135 to 140 pounds (61 to 63½ kg) with typical turntables, arm not included.

It's a monster, rather "industrial" in appearance with the cover off, but quite acceptable cosmetically with the cover in place. Despite the lack of ultimate finish, the cost of parts and labor appears quite high.

So far, adaptations exist only for the Technics SP-10 Mk II and the Denon DP-6000 direct-drive turntables, although there's no reason why the B-1 could not be made to accept just about any high-quality turntable. We have used both the Technics and the Denon adaptations in our reference system and can report that all of the mysterious ailments attributed by cultists to these essentially superior units are miraculously cured when they are separated from their inadequate factory bases and installed in the B-1. More about them, also, in the forthcoming survey.

The main problem with the B-1 is its price. Most people don't even think of the turntable base as an item to be considered in their audio budget, let alone as a four-figure purchase. At the moment, however, there's no device known to us that will do at a lower price what the B-1 does; the closest you can come to it is to play a top-quality turntable several rooms away from the speakers with a long cable between the preamp and the power amp. It's just as good exercise as jogging, and you won't even miss the beginning of the music if the lead-in groove is long enough. Eventually, we're told, there will be a complete Cotter turntable, in which the base should be considerably more cost-effective because of the "systems" approach from the ground up and the elimination of dealer's labor charges. Corrective measures are always more expensive than correct design from the start.

Meanwhile, in turntable bases, the Cotter B-1 is audibly and unquestionably State of the Art.

Cotter B-2

Mitchell A. Cotter Co., Inc., 35 Beechwood Avenue, Mount Vernon, NY 10553. Turntable Isolation Platform B-2, $150. Tested sample on loan from manufacturer.

This is a 16" by 20" laminated plate similar to, though not as thick as, the base plate of the Cotter B-1. It weighs 35 pounds (16 kg) and is suspended at its four corners on large springs. That's all it is. What it does is to decouple any turntable placed on it from floor vibrations and other mechanically transmitted acoustic excitations. In other words, it accomplishes part of what the B-1 was designed for but doesn't do the complete job.

If you have a turntable that's not too "live" acoustically in its basic construction and materials, you might achieve quite excellent results just by putting it on top of the B-2. Organ bass will certainly be cleaner and you'll be able to dance the polka right next to the turntable with impunity. On the other hand, you won't experience the surprising increase in lower-midrange clarity made possible by the B-1's inherent deadness and total insensitivity to airborne excitation. But at least the B-2 is an isolation platform that really isolates, unlike those fake marble slabs on rubber feet that barely do.

Fidelity Research FR-1 Mk 3F

Fidelity Research of America, PO Box 5242, Ventura, CA 93003. FR-1 Mk 3F moving-coil stereo cartridge, $230. Tested #018639, on loan from distributor.

We hate to do this to you, but we like this moving-coil cartridge even better than the GAS 'Sleeping Beauty' Shibata, our previous top recommendation. We certainly didn't plan to have a new reference cartridge in every issue, but we have to call them as we see them. Besides, the GAS has turned out to be rather variable, with some quite inferior samples floating around, whereas every FR-1 Mk 3F we've checked so far has been excellent. We must hasten to add that our preference is based on a perfect sample of one against a perfect sample of the other.

Specifically, the FR has even better resolution of inner detail, greater clarity on top, and more solidity in the middle and on the bottom than the GAS. Better tracing may be part of the reason why; the stylus geometry seems to be even more sophisticated than the Shibata configuration. This is a fat stylus with a very narrow, long-line contact area; FR calls it a 0.3 by

3-mil tip (7.6 by 76 microns). Its lateral contour apparently doesn't permit it to bottom in the groove like a Shibata but the fine "edges" can really get around those high-velocity zigzags. There are also other refinements inside the cartridge, including a unique magnet structure and a silver coil, no less. The F suffix stands for "flat," to distinguish this model from a predecessor with a rising high-frequency response that had to be equalized.

The overall sound of the FR-1 Mk 3F is impeccably clean, accurate, uncolored and musical. Through the Cotter (formerly Verion) transformer with 'P' strapping, it has become our reference cartridge.

Fidelity Research FR-64s and FR-66s

Fidelity Research of America, PO Box 5242, Ventura, CA 93003. FR-64s dynamic-balance tone arm, $600 (optional B-60 stabilizer, $450 extra). Tested #022176 (with #022388). FR-66s transcription-length dynamic-balance tone arm, $1250 (including B-60 stabilizer as standard equipment). Tested #022283. All samples on loan from distributor.

These are extremely sophisticated and beautifully made arms, preferable in many ways even to the Breuer Dynamic, our previous top choice. The Breuer still has the most amazingly play-free and friction-free bearings we've ever seen, and we would still use it with ultracompliant cartridges on account of its lower mass, but the FR bearings are also excellent, and with the medium-compliance MC cartridges we favor the arm mass can be a little higher. Overall, the FR arms deserve to go to the head of the class on at least three counts: (1) they are quite a bit deader (less active acoustically) than the Breuer, eliminating that last little trace of lower-midrange coloration; (2) they are much less fragile and fussy than the Breuer, with the added flexibility of removable headshells; (3) the knurled-knob VTA adjustment referred to in our discussion above is a joy and a convenience no one in his right mind would want to give up after getting used to it.

The difference between the FR-64s and the FR-66s is merely one of length; the former is of the same order as other typical arms, whereas the latter is 62 mm longer from pivot to stylus. Furthermore, the B-60 stabilizer, which attaches under the base and also incorporates the mechanism that raises and lowers the arm pillar for VTA adjustments, must be separately purchased for the FR-64s but comes as part of the FR-66s. Since the FR-66s also comes with an extra headshell ($54) and various other minor goodies, it turns out that the extra length costs only a little over $100 and is well worth that difference in terms of lower lateral tracking distortion if your turntable base is large enough. We suspect that the vast majority of our subscribers will have room only for the FR-64s. (The Cotter B-1 base, by the way, accommodates the FR-66s.)

The arms are dynamically balanced, meaning that the vertical tracking force is applied by means of a spring after establishing zero balance by sliding the counterweight. This is by far the most stable method, also used in the Breuer Dynamic. Everything on the FR arms is well thought out, everything works perfectly (except that the cueing mechanism is overdamped, with annoyingly slow descent), and the sound with our favorite MC cartridges is the best we've ever heard. In some cases it may, however, be preferable to use a lighter headshell than the deluxe jobs that FR provides (such as, for example, the Supex SL-4). And, always, we must keep coming back to that knurled knob on the B-60 attachment; can you imagine just gently twisting this knob and listening for the best sound, as if you were using a tone control, instead of fussing with the arm pillar, shimming up the record, etc., etc., to establish the correct VTA? Recent versions of the Breuer also have a similar adjustment, but (1) it's in an awkward location, (2) you need a screwdriver to use it, and (3) the main setscrew must be tightened after each change. It's not in the same class.

The lateral geometry of the FR arms is in the ball park but not right on the button, requiring just a bit of fiddling and twisting, not to mention ignoring the instructions. And the prices are insane, reflecting the weakness of the dollar against the yen (the arms are made in Japan) plus several large markups between the factory and the end user. But then what, or who, isn't insane in high-end audio?

Series 20 Model PA-1000

Series 20 (a division of Pioneer Electronic Corp.), 75 Oxford Drive, Moonachie, NJ 07074. Model PA-1000 carbon-fiber tone arm, $150. Tested sample on loan from manufacturer.

Series 20 is a name Pioneer made up to market certain high-end-oriented products in the United States without the handicap of the pop-hype image inherent in the Pioneer name. As far as this neat little arm is concerned, all we can say is, "Now you're talking!"

We distinctly prefer the PA-1000 to the Grace G-707, our previous "best buy" recommendation. The carbon-fiber arm tube is better damped, the headshell is removable and also nicely damped, the bearings are at least as good if not better, and the overall construction of the arm appears to be superior. The sonic results bear out these mechanical considerations, and the arm is also convenient to install and to operate. What's more, the lateral geometry is close to being right on the nose, although you still have to ignore the mounting instructions.

If you're not sure you want to invest in something like an FR-64s or a Breuer Dynamic, a hesitancy we can't exactly reproach you for, you could do a lot worse than to opt for this excellent $150 arm. On any but the most excruciatingly accurate systems, you might not even hear the difference.

Series 20 Model PLC-590
(preview)

Series 20 (a division of Pioneer Electronic Corp.), 75 Oxford Drive, Moonachie, NJ 07074. Model PLC-590 direct-drive turntable, $550 with integral base and cover. Tested #XG13497T, on loan from manufacturer.

We're jumping the gun here on our more detailed turntable comparisons in the next issue mainly because of our remarks about the Technics SP-10 Mk II and Denon DP-6000 direct-drive units in the Cotter B-1 review above. The PLC-590 is also a quartz-locked direct-drive sytem, with two important differences: (1) considerably lower price, despite the obviously high-quality construction and finish and (2) an inseparable base made of die-cast aluminum, in which we discern at least an attempt to break out of the pattern set by other Japanese direct-drive designs and reduce acoustical activity to a reasonable level. The base is deader than most, though far from perfect in that respect; the so-called insulators it stands on (reminiscent of the Audio-Technica AT605 accessory units) don't really bring the suspension resonance down to a low enough frequency to be completely effective but at least they aren't just little rubber pimples.

In other words, the PLC-590 is a step in the right direction. The Cotter B-2 platform could supply the mechanical feedback isolation that's lacking, so that the two could make beautiful organ music together and generally let the low frequencies rip at any volume level. All that and a gorgeous quartz-lock drive, too, for a total of $700. That's not a recommendation, just an idea. Tune in next time for more definitive information.

Signet MK111E

Signet Division, A.T.U.S., Inc., 33 Shiawassee Avenue, Fairlawn, OH 44313. MK111E dual moving-coil stereo phono cartridge, $275. Tested sample on loan from manufacturer.

Just in case you figured we're suckers for any high-priced and late-model Japanese moving-coil cartridge, this one we don't really like. The highs are much too hot and fatiguing, the rest of the range insufficiently open and focused. In fact, the cartridge sounds not unlike certain middling magnetics. A second sample from another source sounded similar, and one of our consultants had the same experience with a third sample. That closes the case as far as we're concerned, unless new information arises to reopen it.

Win Laboratories SDT-10 Type II

(interim report)

Win Laboratories, Inc., PO Box 332, Goleta, CA 93017. SDT-10 Type II semiconductor disc transducer, $315 (including power source module). Tested samples on loan from manufacturer.

After three samples of this unique product, we're still in no position to give you the detailed review we promised in our last issue. We won't bore you with the irrelevant details, but through no fault of our own or of Win Laboratories, something prevented us each time from testing the cartridge in depth. We trust that this statistically unlikely chain of events will come to a screeching halt, if we may mix our metaphors, and that we'll have a definitive report ready for the next issue. Meanwhile, just a few observations.

It's quite clear to us that Dr. Win has achieved a higher signal-to-noise ratio and a wider dynamic range than has so far been considered possible with strain-gauge cartridges. He also makes the most beautifully crafted styli known to us; they make others look like muddy baseball bats under the microscope. The sound of the cartridge is either very good or better; what we can't tell you because of the difficulties we've had is just where we rate the SDT-10 Type II against the best MC cartridges. Our conservative recommendation would be that you stick with the latter unless you're on a very tight budget, in which case consider the following idea:

The power source module included in the price of the Win cartridge has sufficient output to drive any power amp. All you need is some kind of volume control in between. You could conceivably use two simple potentiometers in place of a preamp. We've always maintained that it's bad economy to save the small difference between the best cartridges and the cheapies, but saving the cost of a whole preamp is another matter. Again, this is not an outright recommendation, just something to think about. Because no matter what final rating we'll end up giving the Win cartridge, bad it is certainly not.

Recommendations

There's an almost complete turnover here since the last issue, indicating the increasing awareness by equipment designers of the realities of accurate phono playback. We caution you, however, to read all reviews and summaries to arrive at the most intelligent choice for your specific needs.

Best phono cartridge tested so far, regardless of price: Fidelity Research FR-1 Mk 3F.

Best cartridge per dollar: forget it (it's poor economy to save $100 or so on this all-important component).

Best tone arm tested so far, regardless of price: Fidelity Research FR-66s (if you have the room for it) or Fidelity Research FR-64s with B-60 stabilizer.

Best tone arm per dollar: Series 20 Model PA-1000.

Best turntable tested so far, regardless of price: Cotter B-1 system with specially adapted Technics SP-10 Mk II or Denon DP-6000 (fine-tuned choice between the two in next issue).

Best turntable per dollar: Kenwood KD-500.

Cartridge/Arm/ Turntable Summaries and Updates

All of the following reviews appeared in Volume 1, Numbers 4 and 5.

Breuer Dynamic 5A

Sumiko Incorporated, PO Box 5046, Berkeley, CA 94705. Breuer Dynamic Type 5A tone arm, $1250 (including Type 5C fluid-damping option).

An arm made like an expensive Swiss watch, with the world's finest bearings in the four-point gimbals suspension. Outstanding performance, but the Fidelity Research FR-64s and FR-66s are considerably less fussy and fragile, much more convenient to use, and do an even better job in most installations.

Denon DL-103D

American Audioport, Inc., 1407 N. Providence Road, Columbia, MO 65201. Denon DL-103D moving-coil cartridge, $267.

A superior moving-coil cartridge of highly consistent quality, but not quite as smooth on top as the best samples of the GAS 'Sleeping Beauty' Shibata, nor quite as convincingly clear and detailed as the Fidelity Research FR-1 Mk 3F, our top choice.

Dual CS721

United Audio, 120 South Columbus Avenue, Mount Vernon, NY 10553. Dual CS721 automatic single-play turntable, $400.

The turntable is quite good, the arm even better, but if you don't need the automatic feature, the Kenwood KD-500 with the Series 20 Model PA-1000 arm will give you greater precision and acoustically deader construction for less money.

Dynavector 20B

Dynavector, 9613 Oates Drive, Sacramento, CA 95827. Dynavector 20B moving-coil cartridge (with beryllium cantilever), $250.

Made by Onlife Research in Japan, this moving-coil cartridge has sufficient output to require no matching transformer or head amp. Unfortunately, the built-in VTA is so large that corrective alignment is impossible, and the sound is unbearably steely and irritating. We haven't tested the 20C, which is a $350 low-output version.

Dynavector DV-505

Dynavector, 9613 Oates Drive, Sacramento, CA 95827. Dynavector DV-505 tone arm, $600.

An interesting attempt to reduce spurious acoustical activity through sheer mass, but a basically erroneous design. Accurate resolution of lateral and vertical information in the groove is made impossible by the gross difference between the arm's lateral and vertical motional impedances. Extreme susceptibility to warp wow is another design flaw, and early samples of the arm suffered from mechanical play that destabilized the overhang alignment. We don't know whether this defect has been corrected.

EMT Model XSD 15

Gotham Audio Corporation, 741 Washington Street, New York, NY 10014. EMT Model XSD 15 moving-coil cartridge, $420.

Inherently, one of the finest moving-coil designs of all time, but severely limited in tracing ability by the 15-micron spherical stylus. No other stylus is offered, except in oddball private adaptations. The integrated plug-in headshell prevents optimum lateral alignment in incorrectly offset tone arms; this too is removed by some private experimenters. With a modern "line contact" stylus and a standard body, the XSD 15 would still be a SOTA contender.

GAS 'Sleeping Beauty' Shibata

The Great American Sound Co., Inc., 20940 Lassen Street, Chatsworth, CA 91311. 'Sleeping Beauty' Shibata moving-coil cartridge, $240.

Second only to the Fidelity Research FR-1 Mk 3F in clarity and inner detail. Extremely smooth on top. But watch out! We've come across quite a number of substandard samples; the elastomer in the stylus suspension may not be permanently stable in some cases. Defective samples sound pinched, unpleasant and fatiguing.

Grace G-707, G-840F, G-940

Sumiko Incorporated, PO Box 5046, Berkeley, CA 94705. Grace G-707, G-840F and G-940 tone arms: no longer available in the versions reviewed.

The current list of available Grace models includes only one whose number indicates any continuity with those we reviewed; this is the G-707 Mk II, which now incorporates a compliance between the counterweight and the arm tube. We can't endorse this without a retest; as far as the old G-707 is concerned, it has been superseded as our "best buy" choice by the Series 20 Model PA-1000 (see review above).

Grado Signature Model II

Joseph Grado Signature Products, 4614 Seventh Avenue, Brooklyn, NY 11220. Signature Model II stereo/CD-4 cartridge, $500.

Silk-smooth, grainless, nonfatiguing, extremely agreeable to the ear, but somewhat opaque in the midrange and lacking in accurate spatial detail in comparison with superclear MC cartridges such as the FR-1 Mk 3F or 'Sleeping Beauty' Shibata. The VTA is almost too large (maybe altogether too large) for corrective alignment and the stylus isn't of the optimal "line contact" configuration. Those two perversities aside, this may be very, very close to the ultimate possibilities of the inherently limited "moving field" principle. The Signature III, which did not arrive in time to be reviewed in this issue, is a still further refinement of the same design, not a totally different creature.

Harman Kardon Rabco ST-7

Harman Kardon, 55 Ames Court, Plainview, NY 11803. Rabco ST-7 straight-line tracking turntable: no longer available in the version reviewed.

The jerry-built ST-7 has been replaced by the ST-8, a $499 model we haven't tested so far. Whether or not the impossibly

loose and wobbly arm carriage, a disqualifying defect in the ST-7, has been corrected we have no idea. (Our curiosity isn't killing us, we might add. Straight-line tracking is the only 100% correct phono playback principle, but it doesn't readily lend itself to popularly priced executions.)

Infinity 'Black Widow'

Infinity Systems, Inc., 7930 Deering Avenue, Canoga Park, CA 91304. 'Black Widow' tone arm: no longer available in the version reviewed.

The Japanese-made 'Black Widow' now comes in the GF (graphite fiber) version at $245, which we haven't tested. The change is most probably for the better, since the original model had a somewhat live arm tube. Whether or not the bearing jitter we had found was also corrected we don't know. In any event, the considerably lower-priced Series 20 Model PA-1000, also a carbon-fiber model, looks like the best of the staple Japanese arms to us.

JVC MC-1

JVC America Company, Division of US JVC Corp., 58-75 Queens Midtown Expressway, Maspeth, NY 11378. MC-1 direct-couple type moving-coil cartridge, $300.

This is a radically different approach to moving-coil design, and we were quite excited about the fabulous midrange clarity we heard on a very early sample. Our enthusiasm was considerably dampened by an irritating high-frequency coloration we also heard. Now that the MC-1 is about to become available in U.S. stores, we're keeping our fingers crossed that JVC has fixed this disqualifying defect in their production series. If so, the MC-1 may turn out to be SOTA. If not, forget it.

Kenwood KD-500

Kenwood, PO Box 6213, Carson, CA 90749. KD-500 direct-drive turntable, approx. $200.

This could be described as a cheaper execution of the Series 20 Model PLC-590 approach. Direct drive (without quartz lock, of course), "resin concrete" chassis to achieve at least a modicum of acoustical deadening, not much isolation from mechanical feedback, good but not great quality overall. Considering its imperfections, it works remarkably well. For the money, we don't know of anything better or even as good.

Linn-Sondek LP12

Audiophile Systems, 5750 Rymark Court, Indianapolis, IN 46250. Linn-Sondek LP12 transcription turntable, $549.

One speed only (33 1/3 RPM), no speed adjustment, not much torque, some very cheap-looking parts, but beautifully engineered platter and drive mechanism. Suspension and isolation about as good as on the Thorens TD 126 Mk II, with minor exceptions; audible performance definitely as good. The distributor discovered after we had returned our test sample that the bearing housing wasn't filled with oil and claims that the LP12 would have blown away the Thorens sonically had it not been for this oversight. We don't believe that the slight additional friction could have affected the signal in any significant way, but a retest has been scheduled and will be reported on in the next issue.

Luxman PD-121

Lux Audio of America, Ltd., 160 Dupont Street, Plainview, NY 11803. Model PD-121 direct-drive turntable, $545.

This is no longer the top of the Luxman line; they have some expensive new goodies that may or may not have the same disqualifying defect as the beautifully made PD-121. That defect is either mechanically or acoustically excited drumming (thump, thump) of the large, flat base to which the turntable is permanently wedded. There's no cure for the drumming, nor for the thick, woofy sonic coloration it causes. A suggested bumper sticker for Japanese turntable designers: "The only good turntable is a dead turntable."

Mayware Formula 4

Mayware, England, distributed in the U.S.A. by Polk Audio, 1205 South Carey Street, Baltimore, MD 21230. Formula 4 PLS4/D tone arm: no longer available in the version reviewed.

The original version we reviewed was not nearly as stable and dead as we would have liked. The new Formula 4 Mk III PLS4/D1 at $180 is still basically the same silicone-damped unipivot design, a format we feel has certain theoretical and practical shortcomings. Just how the new version performs as compared to the old we don't know.

RAM 9210SG

RAM Audio Systems, Inc., 17 Jansen Street, Danbury, CT 06810. RAM 9210SG Semiconductor Phono Transducer System, $299.

An adaptation of the old Matsushita (Panasonic) EPC-451C strain-gauge cartridge, now obsoleted by the more advanced strain-gauge technology of Win Laboratories.

SAEC WE-308N

Audio Engineering Corp., Tokyo, Japan. Distributed in the U.S.A. by Audio Source, 1185 Chess Drive, Foster City, CA 94404. SAEC WE-308N double-knife-edge tone arm, $195 when reviewed (latest price NA).

This is a very interesting case because the offset angle of this beautifully made arm is so insanely small that it's almost impossible (and in some cases actually impossible) to align the cartridge in its headshell for optimum lateral geometry. Yet, according to the distributor, its designers insist that they are right and we are dead wrong about tracking error. We were supposed to receive their complete exegesis of this theory but haven't so far. (Ahem, ahem.) The arm is also a bit on the massive side for nearly all cartridges, so you might as well relax and forget about it.

Thorens TD 126 Mk IIB

Elpa Marketing Industries, Inc., Thorens and Atlantic Avenues, New Hyde Park, NY 11040. Thorens TD 126 Mk IIB electronic turntable, $500 (without tone arm) when reviewed. (May no longer be available in this version.)

Currently we see a Mk III listed and that only in the C version, complete with Thorens Isotrack arm, at $750. It's the same turntable, though, and a very good one indeed. The suspension and isolation are of the same principle as in the Linn-Sondek LP12 and the results are at least as good if not better. Heavy footsteps and other subsonic excitations certainly disturb it less; the audible performance is indistinguishable from the Linn's to our ear. The TD 126 offers the added convenience of three speeds, electronically regulated, and the overall construction is very nice, although we like the Linn platter and drive mechanism even better. Until we discovered the Cotter B-1 system, this was our reference turntable, though without any deep religious conviction.

Notes Toward the Definition of Two Different "Reference" Systems

We make our first attempt at specifying matched systems to serve as standards of sonic quality. Reference A is an all-out (though not very sensible nor affordable) system for the purist. Reference B aims to provide the cleanest sound per dollar in the middle two thousands.

What we're trying to do here is doomed to at least partial failure from the start. It's infinitely easier to determine which is, for example, the cleanest, most accurate preamp that money can buy than to tell someone sight unseen what his complete stereo system ought to be in his particular listening environment for his particular needs. Any specific combination of components can be much too easily criticized for this or that reason, and we're really asking for opposition and brickbats by committing ourselves to a limited set of choices. On the other hand, the time has come for us to communicate more clearly what sort of total sound we have in mind when we say that something else doesn't sound as good. Concrete examples are the only way.

So please bear with us in this somewhat tentative exploration of constantly shifting ground. We don't even want to print our recommendations as an uninterrupted list, lest certain people with a short attention span should seize upon it as "official" and not even read our qualifications. Hence the format that follows.

* * *

Incidentally, we have confirmation from very high up that picking components for a system on the basis of sonic merit is fraught with intolerable peril. As you may have read in the newspapers, President Carter's own stereo system was selected by lottery instead. His son Chip pulled slips of paper out of a hat stuffed with the names of leading component manufacturers. We subsequently fired our Washington lobbyist.

Reference A

There are no restrictions in this category. Price, easy availability, practicality of installation, convenience in use don't count. The sound is everything. On the other hand, profligate spending as a "head trip" is also eschewed; any-

thing that costs more must manifestly sound better before it's considered for Reference A.

It should be stated at the outset that many well-heeled audiophiles would be better off building their price-no-object installations around either the Beveridge 'System 2SW-1' or the Mark Levinson HQD System. That way they will have one-stop recourse to their Beveridge or Mark Levinson dealer in case of difficulty, whereas Reference A comes from five different sources on the power-amp/speaker end alone. We believe that this "back end" of Reference A is superior to the Beveridge in every respect except dispersion geometry and possibly midrange coherence. The superiority is most evident at the extreme top and bottom of the audible range and, especially, in power capability (i.e., headroom), where there's simply no comparison. Reference A also exceeds the headroom of the HQD System, which it more closely resembles, and is more accurate in several respects while costing incomparably less. Even so, either the Beveridge or the HQD will be more suitable for the consumer who doesn't like to be his own field engineer.

Speaker System

The top and the bottom are obvious choices in the light of our latest findings; it's the proper fill-in between the two that's somewhat problematic.

The *tweeter* is the Pyramid Model T-1 ribbon unit ($990 the pair), for the reasons set forth in our review in this issue.

The *woofer* is the Janis W-1 ($1350 the pair), not because it's the theoretically ideal low-frequency speaker, but because in its current form it's the best such device we know of that can be bought as a system, ready to play. (See also the follow-up review in this issue.)

The *midrange* speaker, selected after the elimination of more immediately promising candidates, is the Koss Model Two electrostatic ($1500 the pair), with its cheap dynamic tweeter completely removed and its midrange panel allowed to roll off by itself without any crossover.

Koss seems to be the only manufacturer of electrostatic panels that are reasonably accurate, free from ringing, and at the same time able to produce very high sound pressure levels in ordinary air. This ability is due to their unique multilayered construction. That Koss doesn't build absolutely top-notch speakers out of these excellent panels is of no concern to us here; all we need out of them is the five octaves from 100 Hz to 3 kHz, and that they do deliver with high accuracy and headroom to spare. The only problem is a very annoying mechanical resonance at 50 Hz, which is knocked down 18 dB by the Janis crossover but still manages to be marginally audible from time to time. (See also Vol. 1, No. 4 for our review of the Koss Model One/A, which suffers from the identical resonance.) We're now working on a promising cure for this far from incurable condition; meanwhile the system is so obviously superior in all other respects that the glitch fades into relative insignificance.

Without amplifiers and external crossovers this is a $3840 stereo speaker system, a price that reflects all the physical and electrical redundancies that could be eliminated in an integrated design. We believe that a single manufacturer could sell something like this at $2500 the pair and make a profit. Compare it with $6500 speakers such as the Infinity QRS and weep.

Power Amps and Crossovers

These are all new and reviewed in this issue.

The Janis woofers are driven by Janis Interphase 1 bass amplifier units ($495 each, two needed), incorporating 100 Hz electronic crossovers with 18-dB-per-octave slopes.

The modified Koss Model Twos are driven by the Rappaport AMP-1 stereo power amplifier ($1800); two of them bridged would be an even better idea, since the speakers can certainly handle the extra power, but one will do quite nicely.

The Pyramid Model T-1 tweeter can be connected in parallel with the Koss (the built-in high-pass filter takes care of the crossover) or, better yet, the latest version of the Futterman H-3aa tube amplifier ($895 the pair) can be used to drive the tweeter separately, fed from the second high-pass output jack on the Interphase 1. It just so happens that the T-1 provides a reasonably good impedance match for the Futterman's output tubes and the combination is really something to hear. On the other hand, the Futterman can't drive the low-

impedance Koss.

Preamplifier and Interface

The sonically most accurate preamplifier we've found so far is a last-minute arrival, the Precision Fidelity C4 tube unit ($1095). As we point out in the review in this issue, it has complete switching facilities for the usual variety of sources plus two tape decks, but no tone controls. Between the C4 output and the Janis crossover input, we specify a Cotter NFB-2 noise filter/buffer ($350) with Cotter PW-2 power supply ($200); we have yet to test a system that didn't sound better after the insertion of this time-domain corrected subsonic/ultrasonic filter, which is also reviewed in this issue.

The Cotter PSC-2 phono stage ($350), similarly powered by the PW-2, appeared so promising in our brief examination of an early prototype that we must contemplate the possibility that production units will surpass the phono stage of the Precision Fidelity C4, in which case we'll recommend plugging the PSC-2 into one of the "aux" inputs of the C4. The latter will remain in the system, in any event, since the Cotter high-level stage with controls is still far off in the future. When it comes, it will also be powered by the PW-2. (Cotter products were formerly sold under the Verion name.) This part of Reference A is still very much in a state of flux.

Phono Cartridge and Transformer

We haven't found anything so far to equal the Fidelity Research FR-1 Mk 3F moving-coil cartridge ($230), which is reviewed in this issue. And we wouldn't even think of plugging it into anything but a moving-coil pickup transformer, a category in which the Cotter MK-2 ($425) rules supreme. The latter is electrically identical and physically slightly superior to the Verion MK-1, which is no longer made.

Tone Arm

The perfect match for the Fidelity Research cartridge is the Fidelity Research FR-66s arm ($1250), which we prefer very slightly to the FR-64s. The two are identical except for the former's greater length and therefore somewhat lower peak error in lateral tracking. The FR-66s fits easily on our Reference A turntable base; in case of any substitutions only the FR-64s is likely to fit. Both are reviewed in this issue.

Turntable

The Cotter B-1 turntable base (approx. $1300; see review in this issue) is mandatory for the kind of immunity from acoustical excitation we require in Reference A under high-level playback conditions. It comes with either the Technics SP-10 Mk II ($800) or the Denon DP-6000 ($680) modified and built in. At this point we have no distinct preference between these two quartz-locked direct-drive turntables, but we recommend that you stay away from their factory-built bases.

* * *

The total retail price of Reference A ranges from $12,160 to $15,205, depending on the various options discussed. Considering what it offers, it's a bargain.

Reference B

This system represents what in our opinion is the minimum level of sonic accuracy that makes it worthwhile to become an audiophile. For anything less than this, a deep involvement in the subject doesn't make much sense to us except as a purely intellectual exercise. The next step down is supermarket audio, even if it still costs a lot of money.

Speaker System

At this level, trade-offs are the name of the game, and it becomes pretty much a matter of personal taste what qualities you're willing to give up and what you consider nonnegotiable. To us, the DCM 'Time Window' ($660 the pair) still appears to offer the best blend of trade-offs. It may not be quite as free from certain audible colorations as the newest generation of "minimonitor" speakers, but it has some bass, without which music is incomplete, and it has plenty of headroom plus good dispersion, so that it's capable of sounding dynamic and alive—like real music. It remains the most appealing speaker for the money.

Power Amplifier

This one is easy. The Audionics CC-2 ($489) may well be the most outstanding buy in high fidelity today. We can count the power amps that sound better on the fingers of one hand, and not one of them is even remotely in the same price category as the CC-2. In a field that's flooded with high-priced garbage, this neat little black box is a monument to intelligence and commercial integrity.

Preamplifier

Out of a number of possible candidates here, we consider the Apt/Holman preamplifier ($493) to be the safest bet. It's amazingly well made for this price range, as versatile in its control functions as any preamp at any price, and sonically surpassed by only four or five units, all at significantly higher prices. (See review in this issue.)

Phono Cartridge and Transformer

Contrary to commercial propaganda and untutored audio cults, conventional magnetic cartridges in the $100 to $200 range do *not* offer high-fidelity reproduction of the information in the groove. We must therefore insist on a moving-coil cartridge and transformer for this all-important stage of Reference B, and they might just as well be the best available, as in Reference A. Get the Fidelity Research FR-1 Mk 3F and Cotter MK-2 combination ($230 plus $425) and be done with it. Reference B is good enough to make compromises on the phono end perfectly audible.

Tone Arm

The Series 20 Model PA-1000 carbon-fiber tone arm ($150) is our choice at this level of expectations, for the reasons explained in our review in this issue. A little more mass added to the headshell, such as a gob of Duxseal, may be beneficial with the medium-compliance FR cartridge.

Turntable

The Kenwood KD-500 direct-drive turntable ($250) is our choice here, with one reservation. Its isolation from mechanically transmitted feedback is quite poor, so that it may have to be placed on a Cotter B-2 isolation platform ($150). The distance of the turntable from the speakers, along with the physical characteristics of the room and the installation, will have to determine this extra expenditure. Even at $400, we don't know of a turntable/base combination to beat this one.

* * *

The total retail price of Reference B comes to either $2697 or $2847, depending on the isolation platform option. That isn't exactly pin money but it gives you what **The Audio Critic** considers high fidelity.

Important Advice

Never judge a power amplifier or preamplifier from the way it sounds immediately after you turn it on. Most circuits take longer to stabilize than you think. Some preamps, especially, take as long as a day or two to sound their best, and all preamps and power amps sound better after a few hours. So leave them on as long as you can. (Those who deny this don't make their living evaluating audio equipment.)

Two More Headphones

By the Staff of
The Audio Critic

It's beginning to look as if good electrostatics were the rule rather than the exception, but a new reference standard doesn't seem to be in the cards.

As we pointed out in the headphone article in Volume 1, Number 5, our headphone tests are necessarily rather similar to our loudspeaker tests. (See also the speaker survey, Part III, in this issue.) The same laboratory measurements in the frequency domain and the time domain apply, except that ways must be found to couple the measuring microphone to the headphone diaphragm in a manner simulating the on-the-head acoustic transfer conditions. Our simulations aren't exactly according to standard practice, as we said, but then standard practice isn't necessarily the most illuminative and, besides, we claim only consistency for our finding, rather than a high degree of numerical accuracy. So far, the most intensive listening tests have shown very satisfactory correlation between what we measure and what our auditioners hear.

Infinity ES-1

Infinity Systems, Inc., 7930 Deering Avenue, Canoga Park, CA 91304. ES-1 electrostatic headphone, $275. Tested sample on loan from dealer.

This is an excellent electrostatic headphone but it isn't made by Infinity. It's made for them in Japan by Mechano Electronic, an outfit that obviously has more faith in time-domain measurements than Arnie Nudell (see Vol. 1, No. 5, p. 11), since the ES-1 reproduces pulses and tone bursts very nicely. Pulse form retention is good even with durations as short as 90 uS, and tone bursts cause little or no ringing across the spectrum except at 3.6 kHz, where the effect is still quite mild. Well done, Mechano.

In the frequency domain the bass is particularly impressive, with extremely smooth response down to the -3 dB point of 30 Hz. High-frequency response goes out to 22 kHz, with some irregularities. Specifically, there are two small rises of perhaps 3 dB each, one from 8 to 9 kHz, the other from 12 to 14 kHz. In between, separating the two rises, there appears to be a little suckout at 10 kHz. No big deal, all in all. (The left phone looked a bit worse than the right phone in our sample.)

The fundamental resonance on the bass end appeared to have a Q of approximately 1, and this very acceptable value was retained over a wide range of drive-signal levels—another excellent design characteristic.

Listening tests with high-quality master tapes verified the deep, well-controlled bass and gave evidence of nicely focused, thoroughly detailed sound from top to bottom, with good dynamic range. Direct comparison against the Stax SR-X/Mark 3, however, turned out to be in favor of the latter. Switching from the Infinity to the Stax gave the impression of stepping into a larger, airier and more lifelike listening environment, even though the bass wasn't as good. The Stax sounded more delicately refined and at the same time more immediate and real, even without the bass. We believe the difference to be due to the Stax's somewhat greater bandwidth and speed. At least we can't find any other good explanation, since in other respects the two units appear to be evenly matched.

Unless, of course, the explanation is mathematical: maybe every design, even by the best Japanese engineers, has a definite limit as it approaches Infinity. (E.g., the 'Black Widow' tone arm.)

Signet TK33

Signet Division, A.T.U.S., Inc., 33 Shiawassee Avenue, Fairlawn, OH 44313. TK33 Electret Stereophones, $250. Tested sample on loan from manufacturer.

Here's an unusually interesting case. This electret (i.e., permanently polarized and therefore cordless) unit turned out to have the flattest, smoothest, most extended frequency response of any headphone we had ever tested, easily within ±3 dB from 30 Hz to 35 kHz. It showed no anomalies whatsoever on tone bursts and reproduced pulses of 0.15 msec width or wider with great accuracy, with just a slight blip appearing on shorter pulses. All things considered, no headphone known to us performs better on the test bench, either in the frequency or the time domain. It's rather sad to report, therefore, that the TK33 is an extremely unsatisfactory device for listening. The problem is power handling.

In any electroacoustic transducer that can be analytically represented as a high-pass filter, there's an obvious trade-off between downward bandwidth extension and headroom, all other parameters remaining equal. For example, a minibox like the Fried B/2 speaker could be designed to go down flat almost to DC if it didn't have to play at any level above a whisper. It's this trade-off that apparently went sour in the Signet. At moderate levels, its bass performance is nothing short of phenomenal, and its overall clarity and focus are exemplary, surpassed only by the Stax SR-X/Mark 3 and not much at that. As the music becomes dynamic, however, the TK33 overloads quite obviously on the louder passages and develops audible distortion long before its neat little LED display indicates an overdriven condition.

We don't believe we had a defective sample of the Signet. The evidence indicates that the Signet engineers got carried away by small-signal specs, at the expense of real-life power-handling requirements.

Recommendations

Despite their superior bass performance, neither one of the above headphones can alter our previous recommendations, which were based on our usual philosophy of clarity-and-detail-above-all.

Best headphone so far, regardless of price: Stax SR-X/Mark 3.

Close to the best at a much lower price: Stax SR-5.

Headphone Summaries and Updates

All of the following reviews appeared in Volume 1, Number 5.

Fontek Minifon A-4

Specs Corp., 1169 E. Chess Drive, Foster City, CA 94404. Fontek Research Minifon A-4 electrostatic unit with C-4 coupler, $300.

A good Japanese electrostatic, with impressive presence and dynamic range, but not without audible colorations. Slightly aggressive on top and woofy below. A second sample checked did not alter our original evaluation.

Koss 'Auditor' Dynamic/10

Koss Corporation, 4129 N. Port Washington Avenue, Milwaukee, WI 53212. Auditor Series Dynamic/10 stereo headphone, $85.

Rough, peaky, unfocused, fatiguing, totally incoherent in the time domain. No longer listed, in any event, at least not under the same designation.

Koss 'Auditor' ESP/10

Koss Corporation, 4129 N. Port Washington Avenue, Milwaukee, WI 53212. Auditor Series ESP/10 electrostatic stereo headphone with E/10 energizer, $300.

Not quite as transparent and detailed as several other electrostatics; somewhat aggressive and not altogether pleasing. Ranks below the Fontek, let alone either Stax.

Stax SR-X/Mark 3

American Audioport, Inc., 1407 N. Providence Road, Columbia, MO 65201. Stax SR-X/Mark 3 electrostatic "earspeaker" with SRD-7 adaptor, $290.

The most strikingly detailed and transparent headphone sound known to us, somewhat lacking in deep bass. Clarity conquers all, however (at least in our book). This is no longer the top of the Stax electrostatic line; we haven't tested yet the highly unconventional SR-Sigma at $450.

Stax SR-5

American Audioport, Inc., 1407 N. Providence Road, Columbia, MO 65201. Stax SR-5 electrostatic "earspeaker" with SRD-6 adaptor, $170.

Almost as good as the SR-X/Mark 3, for considerably less money. Lacking only in the ultimate smoothness and textural delicacy.

Yamaha HP-1

Yamaha International Corp., Audio Division, PO Box 6600, Buena Park, CA 90622. HP-1 Orthodynamic headphones, $65.

Among the flattest and smoothest dynamics, very listenable, but still quite incoherent in the time domain. No match for the electrostatics in clarity and focus.

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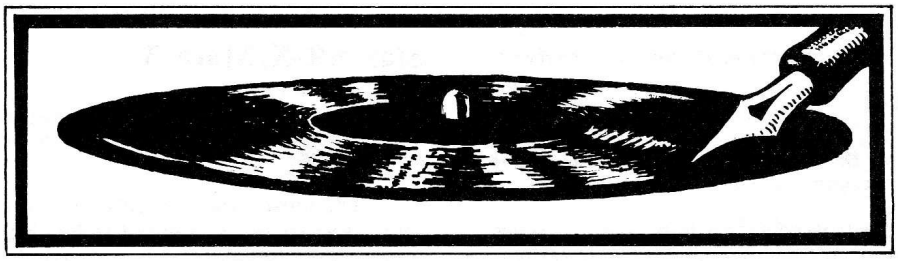

A Discography for the Audio Purist: Part I

Editor's Note: *The latest installment of Max Wilcox's continuing series on recording technique arrived a bit too late to be included here. Watch for it in the next issue; meanwhile, here's the beginning of a new and different series that will run concurrently.*

This is the beginning of what we hope will become a regular feature: brief analytical comments on the records we use for evaluating cartridges, arms, turntables and preamps. The point is that these are the records we actually listen to when we try to find out certain things, which doesn't necessarily make them the greatest audiophile spectaculars in the world. (We don't know what the latter are.)

To be included in this discography, a record need not be an absolute masterpiece of audio engineering but it must possess some special quality that makes it desirable to the audio purist, even if it happens to be somewhat flawed in other respects. At the same time it mustn't be a total loss as sheer music. We refuse to be musically debased or abused even for the cause of better audio.

Needless to say, we also listen to some rather poorly recorded discs, of Toscanini, Dinu Lipatti, Louis Armstrong, early Beatles and many other underprivileged musicians who never saw a Bruel & Kjaer or Schoeps microphone. We certainly hope that you do, too. But the subject here is audio excellence, so that some of our favorite records will never be mentioned.

Deutsche Grammophon

Stravinsky: L'Histoire du Soldat (in English). John Gielgud, Tom Courtenay, Ron Moody, Boston Symphony Chamber Players. Deutsche Grammophon 2530 609 (made in 1975).

Although this is a multimike job (by the renowned Gunter Hermanns), we don't know of a more cleanly delineated recording of instrumental timbres and fast transients. There are only seven performers in the musical sections, and they are right *there*, in front of you. The closely miked snare drum in the "Royal March" is our favorite cartridge and preamp killer, and the savagely bowed solo violin in a number of passages will put any tweeter to the acid test.

Through a system of reference quality all this should sound solid, sweet and crisp, with no audible crud of any kind.

The spoken parts were recorded separately (excellently acted, by the way), and the rather obvious use of echo plates on the voice channels provides another point of reference, since the more clearly you hear the mechanical artificiality of the effect, the higher the resolution of the system.

Musically the performance is superslick and virtuosic; maybe Stravinsky's own recording from the early 1960's on Columbia gets closer to the essence of the music, but this is the recording for sonic delights.

London (Decca)

Prokofiev: Romeo and Juliet (complete ballet, 6 sides). The Cleveland Orchestra, Lorin Maazel. London CSA 2312 (made in 1973).

We must hasten to state at the outset that we use only the first two sides of this album in our equipment evaluations. The other four simply aren't as good; side 6, for example, has unbearably glassy string sound. Act 1, however, is the best recording known to us of a huge symphony orchestra with all choirs active. That doesn't mean it's a superb recording; the modern orchestra has never been captured on records to our complete satisfaction, but producer Michael Woolcock with engineers Colin Moorfoot and Gordon Parry at least had a bash at it, as they say in England, even if they had to go to Cleveland, Ohio, to do it.

Their technique is still multimike, with plenty of spotlighting, but the result has tremendous presence and impact, with a big dynamic range that you expect to run out of headroom on the climaxes but doesn't. The bass drum is especially well captured (good subwoofer test) and the violins are right up front without being strident (on the first two sides, anyway). It's hi-fi with a vengeance, but the very best of the genre. And it really separates the big-league systems from the others.

Musically the album is wonderful; there's no better orchestra in the world than the Cleveland, and Maazel has a total mastery of this extroverted score, which is just modern enough in flavor to make the tovarich in the street think he is enjoying something avant-garde.

Mark Levinson

The first five volumes of the Mark Levinson Acoustic Recording Series, any one of which makes excellent source material for equipment testing, were reviewed in Volume 1, Number 4. This is their sixth release.

* * *

Bach: Partita No. 3 in E Major. Scarlatti: Five Sonatas. Eliot Fisk, guitar (playing own transcriptions). Mark Levinson MAL 6, 45 RPM (made in 1978).

Even the rock-pop generation that avoids unamplified live music like the plague has a good idea what a live acoustic guitar sounds like. That's the chief audio-testing value of this record; with this kind of program material the equipment has no place to hide. There's just a solo guitar smack in the center with a fairly live space behind it; a pair of Bruel & Kjaer 4133's are responsible for the basic sound of the recording, which was made without a console. What could be simpler or purer? What's more, the 45-RPM cut loses very little in the transfer from the 30-IPS master tape. With nothing phony going in, anything phony coming out is very, very obvious.

All we can say about the sonic quality of this record is that it sounds like an acoustic guitar. Period. If it sounds like a pleasant electric recording of an acoustic guitar, there's something wrong with the playback system. It's as simple as that.

In addition, these are superior performances musically. One of the shortcomings of the tiny Mark Levinson catalog has been the use of competent rather than exciting musicians. Eliot Fisk is of another category. He sounds like a major artist to our ears, quite in a class with the better classical guitarists of our time. With this kind of talent and this kind of recording, the MLAR company is rapidly coming of age.

Philips

16th Century French Dance Music. Musica Reservata; Michael Morrow, musical director; John Beckett, conductor. Philips 6500 293 (made in 1972).

The music is rather delightful and completely unimportant; the recording is very closely miked and detailed. We think we can hear some slightly peaky Neumanns in there,

but we don't care. With this kind of front-row definition we can nail some very elusive performance characteristics in components under test.

For example, on the first side, exactly where a perfectly aligned offset arm goes through its first zero-tracking-error position, there's "Belle, qui tiens ma vie" for two mezzo-sopranos, tenor and bass, a cappella. It's nothing short of amazing how this combination reveals the subtlest intermodulation products thrown off by the equipment. The fact that the piece is rather amateurishly sung detracts nothing from its potency as a tool for testing. The dance suite that follows is equally useful, thanks to marvelous ancient instrumental timbres that were originally conceived for short-distance, intimate listening, such as the phonograph again provides in modern times. The bridge sound of the viols, for example, is a perfect time-domain monitor and an absolute joy when all components are optimized.

By the way, Philips is just about our favorite among the big commercial labels; in our opinion only a handful of small, specialized record companies are doing a better job audiowise.

Proprius

This little-known Swedish label has been one of our happiest discoveries in our search for exceptional records. Their productions seem to be consistently natural in sound and flawlessly processed. Furthermore, they maintain a surprisingly high standard of musicianship for a small record company. The album reviewed below happens to be our personal favorite in the Proprius catalog, but we suggest that you also look into *Barock* (PROP 7761) and *Kör* (PROP 7770) or just about anything else on their list for that matter. You won't be disappointed. The distributor in the United States is Audio Source, 1185 Chess Drive, Foster City, CA 94404.

* * *

Cantate Domino (assorted works for chorus, soprano, organ, trumpets and bassoons). Oscars Motet Choir; Torsten Nilsson, choral director; Alf Linder, organ; Marianne Mellnas, soprano. Proprius PROP 7762 (made in 1976).

Truly admirable microphoning characterizes this complex pickup of massed and solo voices with organ and instrumental textures in a reverberant church. Everything is completely natural and in focus; the organ descends to subterranean depths and the soprano soars heavenward; the dynamic range is stupendous and yet there isn't even a suggestion of hi-fi for hi-fi's sake on either side. The recording channels weren't really of Levinsonian cleanliness (we're told that the tape recorder was a mere Revox A77, reworked to be sure); tape hiss and modulation noise are discernible here and there; the basic perspective, however, is so right (a pair of Bruel & Kjaer 4133's again) and everything remains so clear that the listener is totally disarmed. The slightest differences in the smearing and masking characteristics of various playback systems become instantly obvious on this record.

The music on the first side spans four centuries of fairly lightweight but quite beautiful religious music; the second side is all Christmas and all very nice, except for an unbelievably corny arrangement of "White Christmas," with a totally out-of-character organ obbligato by the renowned Alf Linder.

Linder, incidentally, is the most professional participant in these performances; the chorus is very musical and persuasive but occasionally insecure in pitch; the soprano is a good one. All in all, one hell of a record. As our favorite wine merchant, a friend of twenty-five years' standing, is wont to say when we hesitate about one of his recommendations, "Shut up and buy it!"

—Ed.

Editor's Note: *An apparent resurgence of national hi-fi ads demanding admonitory response compels us to be more succinct than usual in our technical comments, to give us room for more items. May we remind you, therefore, that it was never the intention of this column, which is about truth in advertising, to be read as a technical appendix to our equipment reviews.*

AR9

"For anyone who can afford perfection, this is the perfect speaker. The new AR9." So proclaims the ad. Other AR ads in the same vein announce "the best speaker in the world." And the AR engineering department is backing up the campaign with their own special brand of semiscientific, semipopular and always 100% promotional engineering papers.

Well, what have they got? A new method of transduction, more accurate than the moving-coil, ribbon, electrostatic or ionized-air principles? Nope. It's an AR11 with an extra woofer and a lower-midrange driver. That's what.

Let's forget for the moment that audio purists tend to make a queasy face whenever the name of AR comes up (contemporary AR, anyway). Let's assume for argument's sake that AR makes good cones and domes, as well as good crossover networks and enclosures. In that case, their speakers still can't be among the very best, let alone perfect. No cone or dome can possibly have the time-domain characteristics of the best electrostatic panels, ribbons or ionized-air devices. By definition. The only application in which the conventional dynamic driver has half a chance against force-over-area transducers is the woofer, and even there only from about 100 Hz on down. Remember, we're talking about perfection (or at least State of the Art), not just pretty good or even very good speakers.

Of course, even before the AR9 was out, Robert Berkovitz and Bjorn Edvardsen of AR had already asserted in an Audio Engineering Society paper that time-domain distortions in musical program material are inaudible and that existing speaker designs therefore need no improvement on that count. In other words, if you don't possess the cure, declare the disease to be nonexistent.

All we can say is, if the AR9 offers perfection at $1500 the pair without any attention to the time domain, there's absolutely no need for **The Audio Critic**. Since what we claim to hear in our laboratory and listening room is inaudible, our recommendations of even more "perfect" speakers must be irrelevant.

Micro-Acoustics 2002-e

You may have seen that very serious-looking, almost public service kind of ad titled "Phono Cartridges: A Buyer's Guide from Micro-Acoustics." It's a big chart that analyzes five different approaches to cartridge design (crystal/ceramic, moving magnet, moving iron, moving coil and electret) according to their ability to meet a long list of different performance criteria. The upshot of it is that different designs have different advantages, but the electret (the advertiser's design format) has the most advantages. Surprise, surprise.

As we've said before, low-key "educational" ads, by virtue of being highly credible and eagerly read by the target audience, do more harm than the most egregious hype if they disseminate incorrect or incomplete information. In this particular case, a girl with big tits wearing a Micro-Acoustics T-shirt would have been a less offensive and more honest ad to at least one audio-fundamentalist observer.

Examples of "managed" science abound in the ad; for instance, the transient performance (rise time) of electret cartridges is asserted to begin where all the others leave off. The all-important difference between motional impedance and electrical network bandwidth as the limiting factor of rise time isn't even considered. For whatever it's worth, the fact is that moving coil cartridges are capable of a rise time of 5 uS (Micro-Acoustics claims 17 to 20 uS for the electret); the Win Laboratories SDT-10 Type II strain-gauge cartridge (a category eschewed by the ad) specs out at approximately 1 uS. We could go on and on about other tendentious inaccuracies in the chart.

It's interesting to note that the longitudinal displacement of the stylus (the "needle drag distortion" originally described by Rainbow and Codier) is a performance criterion totally ignored in the ad, although it results in exactly the kind of frequency cross-modulation that the ear is most sensitive to. To the best of our ability to judge the design of the Micro-Acoustics direct-coupled electret cartridge, its resolver structure is far from free of this effect. Moving-coil cartridges are on the whole less prone to longitudinal drag and translation effects than other designs; furthermore, their generators are inherently less sensitive to longitudinal excitation when it does occur. This is a subject not to be sidestepped in a "compleat" buyer's guide, unless of course the seller doesn't want the buyer to know about it.

The moral: don't go to a snake-oil peddler to study herpetology.

ADC 1700DD

"The First Low-Mass, Low-Resonance Turntable," announces the double-page spread from ADC. The 1700DD turns out to be a BSR turntable with direct drive, a base filled with "foamed concrete" and rubber feet. That's the low-resonance part of the deal. The low mass refers to the carbon-fiber tone arm.

What's claimed for all this is that it "reduces resonance to levels so negligible they are virtually nonexistent" and that it is "as close as technology has ever come to defying the physical laws of resonance." All that sophistication in a cute little round-cornered package for only $250. Ain't technology wonderful?

Anyone who has read our review of the Cotter B1 turntable base in this issue knows what kind of design, how much mass and how much money it takes to achieve something even remotely approaching those claims. And anyone who knows turntables can take a look at the photograph in the ADC ad and see that the 1700DD hasn't even got a suspension to speak of. The only laws being defied here are the ones applying to advertising claims.

We'd like to address the following question to ADC: In a system with decent woofers, playing symphonic music at a realistic level (peaks well in excess of 100 dB), how far below the program level does the 1700DD keep spurious signals from, say, 500 Hz on down? Our guess is about minus 15 dB. Tell us, ADC, by how many dB we're off. We suspect we're being generous.

Pioneer PL-518

Pioneer's recent four-color ads for this new direct-drive turntable explain that other manufacturers give you "flimsy plastic or metal headshells," whereas the headshell on the PL-518 "is made of glass fiber, a substance with far greater mass yet less weight, which is unaffected by resonance."

We can't tell you how thrilled we are that Pioneer, for only $175, is now able to provide its turntable with an antigravity field in which mass and weight have a different relationship than elsewhere on earth, where your turntable and mine operate. With their resources and their advertising agency, we always knew they could do it.

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The Audio Critic

In the next issue:

We devote a large part of our space to something different and consequential: the transcript of a no-holds-barred seminar on the State of the Art, featuring the candid views of the handful of experts we respect the most.

A leading authority discusses the nitty-gritty of stylus design and tip geometry.

We gingerly approach the booby-trapped subject of FM tuners.

Still more on cartridges, arms and turntables, especially the latter.

Plus speaker, power-amp, preamp and other reviews, not to mention our regular columns.