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## Whales, Porpoises and Sonar

William E. Schevill, Woods Hole Oceanographic Institution

Woods Hole, Massachusetts

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Edgar H. Felix, **EDITOR**

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## WHALES PORPOISES and SONAR

William E. Schevill, Woods Hole Oceanographic Institution Woods Hole, Massachusetts

First, I should confess to you that I have been known by all my friends for many years as an arch-enemy of radio, but you needn't take this personally. I don't understand electronics, and so it and I don't get along very well. For this reason, I don't intend to talk about electronics more than occasional allusions.

Mostly, you can foresee, I shall be talking about whales and porpoises. And I hope that we will ultimately, if I don't run out of wind, come back to a connection with radio before I am done. I don't know to what extent you people are acquainted with whales, but you probably know that many of them are large. This is true. Among the whales are the largest animals that we have any knowledge of. But they come in all sizes from about five feet long to nearly a hundred feet full grown. The very big ones we don't see much any more, because the commercial whalers are killing them faster than God makes little ones. So that nowadays a blue whale, the kind that used to be captured at nearly a hundred feet, is pretty big if its length is in the eighties now.

The important thing, I think, at least in my interest of them, is that whales are really not proper sea animals. Fish, for example, have stayed in the sea throughout their entire evolution. Whales, on the other hand, seem to be rather recent re-arrivals in the water. Their ancestors were evidently land mammals. We don't know exactly what they were like, but probably something like, let us say, a cow, or a pig, or a horse, perhaps, rather than a carnivore. In any case, they were four-legged animals, presumably covered with hair. They took to the water again, for reasons not by any means clear to us. Maybe it was easier to make a living there, and maybe there were population pressures on land. In any case, all the links here are missing. We assume that there may have been a development which may have resembled, at an early stage of adaptation, an animal like an otter. Perhaps at a later stage of adaptation, an animal like a seal, although none of these animals are in any way suspected of being in the family tree, or trees, of the whales (there are really two main lines, outwardly rather alike, but not closely related; we'll come to this later). In any case, what we now have is an animal which is superficially fish-like. It has fins, but they're not like a fish's fins. The one on top and those at the rear end, which are the propulsion, are new growths. The hind legs have disappeared, and all that is left in the way of appendages is the pair of front legs, which have become flippers. This fish-like shape is impressed on the animal by living in the water, and swimming through it at appreciable speeds. You can hear about almost any speed and I've been told up to eighty-three knots. Measurements have never passed twenty, which is still a pretty respectable speed.

This new medium they are living in, the water, is a hostile medium. By this I mean that although they spend their entire lives in it, they are in perpetual danger of drowning, just as any other air-breather is. In fact, this hap-

pens to whales. Nevertheless, they have become so well adapted to the water that they are born in it, and can not come out of it without dying. A beached whale is almost certainly a gone goose. There are very few cases of beached whales getting off the beach and surviving.

There is a primary reason for this. It has to do with a problem that arises when a warm-blooded animal lives in the water entirely; thermo-regulation. Being mammals as we are, they are homeotherms. That is, they have a thermostat on their furnace and maintain a fairly constant heat. Their temperature is not really very far from ours, within one or two degrees, but it's all in the upper thirties, Centigrade. This creates quite a problem when you're living in water, which has high conductivity. For a man to maintain his temperature in water, it has to be about 34 1/2 degrees C (or 94 degrees F), as you have in some diving tanks and swimming pools. The ocean isn't like this, and most of it is much closer to freezing. Most of the whales live in cold regions---in the Arctic and Antarctic---and yet they manage to maintain their temperature. It seems at first sight rather disadvantageous to have these long, broad, flat fins, which look like ideal radiators and dissipators of heat. When you look at them a little more closely and cut into them, you find that the circulation, the plumbing, of these fins is a very fancy bit of countercurrent engineering, in that the artery which carries the warm blood out from the heart to the extremities is surrounded by a bundle of small veins which are the return circulation. When this circulation system is being used, it means that the warm blood on the way to the edge of the fin is cooled by the cold blood returning, so that a very small amount of heat is lost to the surrounding water. Most of it is picked up by the returning blood and taken back into the body. An additional fancy feature is that if, for some reason, they wish to dissipate heat, as in much exercise, perhaps, or in warmer water, they pump blood through so hard that the small veins close under the skin, losing a maximum of heat.

Another of the things they have had to learn how to do, of course, is to hold their breath longer than most other air-breathers, or most air-breathing mammals. They have become expert divers, not in what we call skin-diving, but in what I might call "clothespin diving". They do not use compressed air; it's as if you went down with a clothespin on your nose. They stay down there for an appreciable number of minutes. Probably the champion is the sperm whale, which is reputed to stay under water from a half hour to an hour, and which can dive to depths of more than three thousands feet.

The feature that particularly interests me is another function of living in the water. This results from the general opacity of water to most forms of information dispersal or retrieval. As you know from your work in radio, water is very opaque to electro-magnetic radiation, so that neither radio waves nor light penetrates it very well. Therefore, electrical systems of location and navigation in aquatic animals tend to be rather short range

(there are some fish, at least, that use electricity this way). Light, of course, is fine; it gives almost instantaneous information when it is very rare. Visual ranges of twenty feet or less are much more common, and half the time, in the long run, it is night. The one form of energy that really seems to transmit well in water is acoustic energy. So it's not surprising that as we get better and better acquainted with aquatic animals we find that most of them are acoustically well-developed. In the case of the whales, we have for long rejected this information, except as to hearing, for hunters have long known that whales could hear because they could be scared away.

But in regard to sound production by the whales, we have persistently ignored the hints. In past centuries fishermen and sailors knew that whales and porpoises had voices. They reported this, but the learned men on the shore had been listening to anatomists who had cut up whales and found no vocal cords. The anatomists said the animal must be mute, and so scientists concluded that the sailors were just telling yarns. Now we're beginning to know better again and we've found out that the sailors weren't entirely yarning. Even humans don't need vocal cords to talk, as is shown by certain cases of pathological larynges. This condition does not necessarily prevent a man from talking, although not as easily as the rest of us.

Since the transmission of acoustic energy through the air-water interface is so poor, it is not surprising that before underwater listening equipment was developed, so few men heard the sounds made underwater by the whales. The early accounts were mostly from arctic sailors, for they not infrequently experienced great silence, in a dead calm among the ice, so that there was no water motion. Then they could hear whale sounds through the water surface, but especially through the hull of the ship, which acted as a resonator. Now ships are noisy, with generators and compressors always running, and such accounts have become rare.

The matter of how whales make sounds and why they do so is more complicated, and we are still mostly in the conjectural stage. I propose later to give you a few bursts of samples of the kinds of sounds that whales and porpoises make, to give you some idea of what sort of material we are dealing with.

Once it was demonstrated that whales and porpoises made underwater sounds, the question arose as to their utilization. The idea that they might be communicative was not very startling, and aroused little discussion. The long-observed responses to distress or hunting now seemed easily explained, although many accounts spoke of some "sixth sense" communication.

But, perhaps because our awareness of deliberate, volitional whale calls did not come until nearly fifteen years ago, when we had become accustomed to our own clumsy hydro-acoustic efforts in sonar and had been taught by Griffin and his co-workers that bats used acoustic echolocation, the possibility of the use of these sounds for navigation suggested itself to almost all students. It took us some time to really demonstrate this, which we finally did about eight years ago; by now a number of people have performed this experiment. The best test was made only a few years ago in California by Professor Norris, who succeeded in blindfolding a porpoise by fixing rubber section cups over each eye, (obviously a trained and docile captive). With this animal thus blinded, he could keep it in broad daylight and clear water and watch it avoiding obstacles and finding food fish thrown to it.

We don't know as much as we sound as if we did, because so far all of the experiments on porpoise echo-location have been done on animals of the same species, *Tursiops truncatus*, the familiar bottle-nose porpoise that you've seen in Marine Studios and the other aquariums

and circus shows. It happens to be a very good animal for experimental work because it thrives in captivity. On the basis of less than a dozen experiments, we extend from this very short base line the idea that all other porpoises making some sort of clicks are echo-ranging. The clicks all sound pretty much alike, so that this is quite possible.

The first cut on the tape is of a single, captive *Tursiops truncatus*, in fact, the one which first convinced us that he was echo-locating. In captivity, this one animal uttered what we now believe to be echo-ranging clicks. These impulses are broad-band short clicks which seem to have energy all across our band, with any of the analytical gear we've used.

You will hear one squeal (like a short whistle), which is a sample of their other basic sound. (We will hear more from other animals later). Just to give you an impression of how well spaced and how regularly timed these clicks are, we will play the first cut at natural speed as the porpoise swam around its pool, clicking at an increasing rate (up to about four hundred per second); the next cut is the same thing slowed down to one eighth speed so you can detect most of the individual clicks.\*

The next example is of a sperm whale. As far as we know, it utters nothing but clicks.\* The clicks of the sperm whale are like the others; they're right across the board, with emphasis in particular bands, however. In fact, we found when we looked at them in detail, that individual sperm whales produce different wave forms. We're beginning to suspect that we can separate individuals by their signature.

Next we show squeals, the other basic porpoise sound.\* These last two cuts were made at sea, over the Hudson Canyon not far from New York. Naturally, you notice higher background. We always record broad-band because we don't want to lose any of the signal. These squeals, as you can see, are fairly narrowband. In fact, they have different frequencies in different species. It's one of the ways we can get some hints in telling them apart.

The next animal is one usually called blackfish, or pot-head, which exhibits more complicated conversation. This is a very noisy beast; you'll hear squeals, Bronx cheers, and clicks all together.\*

You may not agree, but this seems to me very difficult to explain a burst of uproar such as this as purely accidental. It seems to me that this must have some conventional, communicative value. The recording was made in Trinity Bay, Newfoundland, several years ago, in the presence of just short of a hundred of them. I know the number because the next day they were all driven ashore and killed.

This give you an idea of the repertory of the toothed whales. I mentioned earlier that even though all whales look pretty much alike, there are two very different groups of them. One, the toothed whales, includes all the ones mentioned so far. There must be at least eighty to ninety different kinds of them, or species, in the ocean. Most of them are small, such as porpoises, six or eight feet long, and the biggest is the sperm whale which you have just heard.

The other group of whales, including only about a dozen species, do not have teeth, but instead baleen, or whalebone as it is called, which is a fringed filter that hangs from the roof of the mouth, and with which they do their feeding. This is a very different kind of beast, anatomically, and also acoustically, as you'll see. For one thing, we've never caught them uttering sharp, impulsive, click-like sounds, which we think we can account for by the observation that they don't eat individual prey. All the tooth-

★ (TAPE DEMONSTRATION)



ed whales seem to go after, at the last moment at least, a particular fish; they don't just charge in and take a mouthful of chowder. But these filter-feeders are soup-strainers. In fact, their technical name is from the Greek word for moustache: moustache whales, *Mystacoceti*. Their moustaches differ from ours by growing inside of the mouth instead of outside it. The open-mouthed whale swims through a mass of water that contains small animals, usually small, shrimp-like things.

However, this is still a pretty thin soup. We've sampled the water where we've seen the whales feeding, and though may be only one bit of feed per cubic yard, it is still rich enough to make it worth the whale's while. Sometimes it's richer than that, enough to color the water. In any case, once the whale has enough in its mouth, entangled on the hair-like inner fringe of these filters, it shuts its mouth and, presumably, licks or sucks the feed off the filter, which are very well adapted to back-flushing. The outer part of the baleen filter, towards the lips, is hard and smooth, and the part facing inward is very fringed and hairy. Often in a dead whale you find some of the last meal tangled in it.

You'll now hear samples of the sounds of these whales. These tend to be of lower frequency. Much of it is below five hundred cycles, some as low as twenty or below. . . I'm not sure what these sounds are used for, in fact, we haven't any knowledge of that. They do not seem to go with feeding, at least in right whales, which you are now going to hear. I've often watched them feeding off Cape Cod; we never heard a peep out of them when they were busy feeding. They tend to their dinner and don't waste their time talking. They just swim along with their enormous mouths open, ----- and no music. The time we hear them is when they are playing about, and it looks as though boy is meeting girl. This is the spring of the year and we see quite a lot of this, mixed with gymnastics. The sounds do not appear to be related to food, which is not surprising since these low frequency sounds certainly wouldn't be very good for picking up small things. It's possible they might give a useful echo off of a dense swarm of feed, but, as I say, the whales don't seem to be using it.

You are next going to hear a hump-back whale, which gets to be fifty or so feet long and is a very grotesque looking beast with flippers almost as long, relatively, as a man's arm --- fifteen-foot flippers. It's a very frolicsome animal that often jumps out of water, and is responsible, I'm sure, for a lot of sea-serpent stories. It scares people and makes huge splashes. These sounds you're going to hear were recorded on one of the banks near Bermuda. You will hear echoes, presumably from the bottom. I don't know what these sounds are for. It suggests a couple of whales enjoying themselves.\*

If you're lucky and have a good technician, you can, in good weather, get records as clean as this. This is one of our great problems at sea. In the first place your ship makes more noise than the animals you want to listen to. Before you can do much, you have to get close to the beast and you also have to silence your ship. This isn't quite so hard to do if it's your own ship and you have some control over it, as we have managed to do over certain parts of our fleet at Woods Hole, putting in large battery banks so that we could turn off all the machinery and still have enough juice so that the crew can read in their bunks and not get restless. In one of our ships, for example, we could run all our gear off the batteries, not only for this kind of work, but for some other acoustic work that we do, for as much as eight hours before we'd have to put in a charge.

We still find it pays to get the hydrophone as much as a thousand feet away from the ship, so that such sounds as the water slapping against the hull won't sound unduly loud to the hydrophone and give the whale noise some chance. On the other hand, you can't always win, and when people see you drifting, they're apt to drive up and see if they can help you. The next tape is of a whale-catcher coming up to ask how I was doing.\* This is pretty frustrating, and I may say that an outboard cruiser can be just about as bad, although not so entertainingly varied.

I'd like to talk a little bit about some experiments people are doing on trying to find out how these sounds are made. It's very hard to observe the beast. Water is a poor medium for us to work in, and a porpoise out of water doesn't do so well. It is further complicated by the fact that they don't open their mouths to talk. By contrast, if you are in the woods and hear a bird squawk, and look up and see one with his beak open on the right bearing, you can assume that that's the bird you're hearing.

Now, porpoises and whales have the larynx or Adam's apple permanently intranasal. That is to say that the tip of the larynx projects right across the mouth up into the back of the nose. This means that the mouth has nothing to do with the talk. It's only for biting and swallowing. You can almost say that these animals talk with the nose, in the sense that the air that makes the sound passes . . . through the larynx into the back of the nose. I don't know enough about the baleen whales (the moustache whales) to go into similar details, because we haven't worked on them.

However, in the case of the smaller toothed whales, the porpoises, we have worked on many. We know something of the anatomy and have done some experiments with the larynx. It's true that there are no vocal cords as such, but vocal cords in the mammals that have them are not necessarily homologous, anyway. They seem to be somewhat adventitious structures. In the whale larynx there are projecting bits of cartilage and stretches of membranous tissue which apparently can vibrate just as vocal cords can. We've satisfied ourselves of this with some rather crude experiments. The human laryngologists did this several generations ago, and we got around to it on whales about fifteen years ago. We took the larynx of a fresh-killed animal and pumped air through it. Many . . . people have objected that the resulting squawks have not sounded like a live porpoise, this doesn't disturb me much because if you were to do that to one of us, it wouldn't sound very much like a New Yorker.

I believe that the squeals (or "whistles") are probably produced in the larynx; the clicks may well be made in the external parts of the nose. In the parts of the nasal passages outside the skull are several paired sacs which can be differentially inflated. Many students believe that the clicks are made here. Behind these sacs the face of the skull is dished, with the concavity forward and upward. In front of them is a lump of fatty tissue called the melon; this makes the lump that is often called the forehead, although it's actually part of the nose.

Several people have suggested that this melon is an acoustic lens, though no one has yet made measurements on it. The best evidence for this is in the work of Professor Norris (the man who blindfolded the porpoise). He found that his blindfolded animal, when it was just more or less idling in its private bathtub, would collect bits of fish dropped in front of it. But once the fish got below the level of the snout, or dropped behind the head, it fail-

★ (TAPE DEMONSTRATION)

ed to find them. So, it seems very clear that, from those experiments, there is a favorable field upwards and forwards. (The names melon, by the way, is no frivolous term; when you cut into one of these it looks very much like a ripe canteloupe. It has a somewhat similar cellular, fibrous structure out of which you squeeze, instead of melon juice, a very fine oil.)

Thus it seems likely that the clicks are reflected forward from the dish-faced skull and concentrated by the melon into an acoustic beam used in echo-location. Some tentative sound measurements in front of clicking porpoises, reported by Dr. Lilly, seem to confirm this.

There are some other curious features of the acoustic system. On either side of the larynx is the position of the ear. The structure of the inner ear is not unlike the human ear, but it differs from other animals, including the baleen whales, in a number of respects. One of them is that it is isolated from the skull; it is ligamentously suspended from it. This seems a little odd at first, to think of the receiver flanking the transducer; how does he keep from deafening himself? We think it's shielded on the inner side by what's left of the middle ear, Eustachian tube, and facial sinuses, which are apparently filled by a foam. This is part of the diving problem as well. Both the fine division of the air in the foam and the high degree of vascularization that permits the engorgement of this tissue with blood tend towards a minimum of gas and a maximum of liquid. Of course, if the good Lord really wanted to make it easy for it to dive, he'd have filled the middle ear with rancid butter of something, then it wouldn't have had this trouble.

Thus, it looks as if we have a transmitter directed forward and two receivers which are shielded from the transmitter, consequently with binaural acuity. So far there has been only one such test made of a porpoise; this was made by Dr. Dudok van Heel in the Netherlands a few years ago. He got, allowing for wave lengths, about the same acuity as you get for a human. I don't know if he had an average porpoise, because he had only one and it died before he was finished. Nobody has done it since.

Now we'll actually come to radio. A right whale, one of the moustache whales, is shown in the figure. The mouth is partly open, and you can see the long, whalebone hanging down inside it. The whalebone is about six feet long in a fifty foot whale. It's quite a large mouth; as the old timers used to say, you could drive a horse and sleigh into it. I'm not sure of that, but it's a big mouth.

This whale is now a very rare one because it is easy to catch, so that the old timers nearly killed it off. It was abundant when the Pilgrims came, but by 1700 it was rare and has been ever since. In the North Atlantic the nineteenth-century Yankee whalers logged thirty-five individuals. We have now seen thirty-five in one morning from an airplane; they're coming back a little bit. We see them on our coast from late March through April, occasionally into the first week in May. The rest of the year, I don't know where they go. All we know is that we see them every spring off our coast. We've recognized the same individuals sometimes from photographs, from the spots on them or nicks in them, but we haven't any idea where they've been. They're not hunted, so we can't utilize the usual way of tagging whales, which is to shoot a stainless steel mark into the animal for later recovery when it is cut up and cooked. So, a couple years ago, I thought in desperation that I might make use of a small radio that American Electronics in Philadelphia had made for tracking pigeons for the Office of Naval Research. We put it in a pressure-proof case and then went to a lot of trouble to attach it to a whale. It involved flying around in an anti-submarine helicopter and leaning out the door and dropping the thing on the whale's back. The whale didn't like it and jumped up nearly as high as the helicopter. We saw the radio again twenty-four hours later, still stuck to the whale's back, but we never heard it. We never knew what the trouble was; perhaps the antenna got a bad kink in it and didn't rise up.

Even if the radio had transmitted, we'd have had plenty of problems. We had to be able to detect and get a rough bearing on a signal that might not last a second. These whales are fairly sedate, and sometimes stay at the surface long enough to permit a longer transmission, but we couldn't count on that. W. A. Watkins contrived a receiving antenna that resembled three intersecting screen doors covered with chicken wire. This six-corner reflector permitted rough but instantaneous bearing, but with a 50-foot antenna-height our ship allowed us a maximum range of scarcely over five miles. So we mightn't have held that whale long even if the radio had worked.

I'm hoping next spring to try again with some other gear and I'm certainly open to any suggestions from any of you. What we're thinking of using this time is not a ship, but an airplane. For one thing, ships are both too slow and too expensive. Using airplanes; we needn't be hampered by the necessarily short antenna on the whale, for having the receiver high in the airplane we hope for ranges of at least fifty miles.



Now I haven't talked much about communications, which is what I gather some of you are interested in. I'm not really about to because I don't know much about it. It's not that I don't care, but I've worked mainly with animals at sea and it's very hard to tell which one you're listening to or what it is doing. You don't see it very much. We've tried a little bit of underwater observation, but visual ranges are too short to be of a great deal of help.

I can't say much about the porpoises that are said to talk English, because I don't know just what to make of it. This work is being done by Dr. John Lilly and his Communication Research Institute. He is a brilliant man, and a very able manipulator of animals and operative techniques. There must be something to what he says, but I can't follow it all. For one thing, it does show that if these easy-going porpoises (Turslops) are kept under unnatural restraints, they may resort to unnatural behavior, including mimicry of some of the sounds they hear. I know of no evidence that they do any mimicking in their natural state.

A striking feature of this porpoise mimicry is that it is so poor. It is vastly inferior to the performance of parrots and other birds, which are not usually thought of as very brilliant. The porpoises, bright as they are, are evidently not flexible enough to contrive close copies of our speech. Of course, the differences in propagation velocity between water and air may have something to do with it.

Why do people expect them to do this? I don't know, except that they seem to be so darn bright. It's not new that people have thought this. In just about every scientific generation there have been, in some European language, neurological papers discovering what a man-like brain the porpoise has. People say it's remarkable, then simmer down, and forget about it again. It is very much like the human brain in many respects, it's highly convoluted, and the porpoise has a bigger brain than a human by quite a lot. Dr. Lilly seems to feel that absolute size is important, but I've never been able to get a reading on this from neurologists; I'm not competent to judge it. His argument is that one the animal's brain is larger than about nine hundred grams, it is capable of learning speech and using language. He keeps hoping that he can get the porpoises to speak English, I guess. All I can say is power to him, but I don't understand it.

I think that's probably about enough. If any of you wish to ask anything, some of us will try to answer you.

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This paper was tape recorded at the 1963 Radio Club Banquet by Wm. Offenhauser and transcribed by Claude Minter, with final editing by the speaker. We wish to acknowledge with thanks the efforts of these men. A photograph of the speaker and the several invited guests and commentators in this field, appeared in the Proceedings Issue 1 of 1964.

## Newsbriefs

We hear that Huntingburg, Indiana the home town of our fellow member, Ben Miessner, has set up a scholarship foundation in his name, at Purdue University. A local Science Building was also recently dedicated by the Boys Club there. Here is a combination where the younger ones are stimulated and the older ones recognized for creative leadership that promotes progress. The Radio Club extends its congratulations to Ben.

## EDITORIAL COMMENT

**BROADEN THE SCOPE OF THE PROCEEDINGS?**  
After an association with a few issues of the Proceedings of the Radio Club, your present Editor is convinced that the competition has largely dissipated the motive force that once made this publication useful and sought after. Its purpose is in need of critical self-examination of objectives and pattern. The first issue of these Proceedings appeared four years after the founding of the Club, and promptly became a forum for the publication of historical papers delivered by the principle inventors of the radio art.

The diversification of what we once used to call the radio art has led to a proliferation of technical publication by engineering societies and commercial publishers. The trend in substance of the technical paper now appearing in these publications is toward greater specialization.

The Radio Club Proceedings have suffered in this rapid trend toward fragmentation of reader interest. No matter how diligent our papers committee may be in securing the most competent and revealing of speakers, his subject will be of special interest only to a minority of technical experts in a particular branch of a widespread electronic industry.

Should the Proceedings of the Radio Club of America undertake to present fundamental issues affecting all... branches of our industry? Technical specialization has left radio without a forum for discussion of the great issues which will make or break its future.

What is happening to inventive creativity as a result of marshalling our technical skills in mass production laboratories? Is the lack of reward and recognition to the inventor and the current trend in patent adjudication drying up the creative spark? Is the advertising barrage in radio and television producing a forum for mediocrity? Can automation and electronic management of production produce mass idleness and a permanent class of wards of the general public? I could go on at length to name more of such by-products of the electronic age, the solution of which is now being left to politicians.

For this publication to change its policy from serving as a technical proceedings to one presenting economic and social debate require careful study, solicitation of opinion and deliberate decisions. To this end, your editor invites correspondence, pro and con, on the subject from the club membership.

Edgar H. Felix, Editor

## Newsbriefs

The Editor of the IEEE Student Journal recently announced a contest for the best "Prophetic" article submitted by an undergraduate student for publication in that Journal, to be awarded in honor of that "Ponder and Prophet" of early radio Hugo Gernsback. Hugo, as you all know, is a Fellow of this Club. By his almost endless prophecies since the early years of this century he has become known as the father of science fiction. The catalogue of the radio items available at his store, started in 1905, became the bible of all radio experimenters of the time. We commend the Student Journal in this contest aimed at fostering creative thinking.

# new books

"On the Early History of Radio Guidance," by Benjamin Franklin Miessner San Francisco Press, 1964. \$2.75. 86 pages, 37 illustrations

This little volume presents additional backing to a critique by Lloyd Espenschied to a paper by John Hayes Hammond, Jr., and E. S. Purington that appeared in the IRE Proceedings (47, 1253-1268, 1957). Mr. Espenschied, writing as a member of the IRE Historical Committee, reported the state of the art at the time the work was done and refuted the claims of Hammond and Purington to the guidance phase of technology. Miessner quotes from his detailed working notes showing that the inventions involved in the development of the radio controlled torpedo resulted from his work at the Hammond estate at Gloucester in 1912, and were made by him and a corps of consultants, including such pioneers as Fredrick Lowenstein, George W. Pierce and Henry Leon Chaffee.

The controversy is of little importance now and Miessner wrote "without rancor". However a high honor, the 1962 IRE Medal of Honor awarded to Mr. Hammond may well have been influenced by the claims in the IRE article. The claims in the book are supported by excerpts from publications of the time, including a book "Radiodynamics" (D. Van Nostrand, 1916) which described the project in detail and by presentations before various AIEE groups and testimony in patent cases all unchallenged.

Much of the early work in vacuum tube technology is clouded in controversy because hundreds of engineers and inventors worked simultaneously and independently, much of the time under pressure of war and threat of war. However, Miessner's notes are complete and conclusive as to what he and the associated consultants did and that, although absent on a European trip during the summer that the work was done, Mr. Hammond did provide the boats, the location and the money. The book provides a lesson in the value of good working notes, a Miessner discipline for which he gives Lowenstein due credit, in the importance of earliest feasible disclosure and in clearly stated employer-employee arrangements as to patents.

E. H. Felix, Reviewer

## CREATE OR PERISH

The Case for Inventions and Patents

by Robert H. Rines. 146 pages

The Academy of Applied Science, Cambridge, Mass. with permission of M. I. T. Press. Price \$4.98

This is a very businesslike volume which at first treats the inventor and the patent system in a sober and factual manner but finally bursts out as an impassioned champion-ship of the creative inventor, a fire which smolders in the background throughout the volume. Mr. Rines in the background throughout the volume. Mr. Rines is a lecturer at the Massachusetts Institute of Technology and speaks with authority.

The author first discussed the constitutional and historical origin and the early role of the Patent Office during the age of invention and of the inventor. It illustrates the protection which the patent offered in the case of Alexander Graham Bell and then speculates how the courts would react today to a consideration of its validity. The author analyzes the position of appeals courts and the attitude of judges with respect to the factual issues surrounding the question of invention; the needs of the patent office to attain prompt action and greater assurance of successful sustaining the validity of issued patents and the need for more than procedural review in appealed cases.

In the final chapter, dealing with the effect of present patent procedures, the relations of inventors with corporations and the kind of protection now afforded the inventor, the author expresses the view that inventor-corporation-patent relations are producing an era of creative stagnation. This is further compounded by reliance on government funds instead of creative zeal, for support of the work of inventors.

Edgar H. Felix

## Newsbriefs

An entirely revised Yearbook is now being completed by the Yearbook Committee under the guidance of William Finch. It will be in the mails soon after this issue is in your hands, and will be available for display at the Banquet on November 20th.

This year's Banquet is an important one, and in order to make it an even-greater event certain expenses in the normal budget have been subsidized, so the price will be an even fin. The space is limited however, (to 200) and from present indications will be fully taken up by advance registrations. We accommodated several dozen drop-ins without registrations last year, but commitments are rigid and can probably do no better than fill in for those unable to get there the last minute. Incidentally, a good P. A. system will be on hand.

Confidentially, the Speaker, John Pierce is not only tops as a scientist but some of his friends have whispered, that he is a well known author of science-fiction, under the name of J. J. Coupling!

Periodically, for many years, the various Editors of these Proceedings have attempted to augment the editorial coverage in its pages, by including more short items relating to the activities of its members - changes in activities, mailing addresses, their embarking on interesting technical hobbies. Upon the issuance of the New Yearbook, we will hereafter note changes in addresses as you move around, and changes in employment, if we can get this information first hand (not by noting undelivered mail by notices from the postoffices). We hear of interesting sidelines undertaken by some of the members who are putting their years of experience in carrying out some unusual pursuit. We would like to report on these efforts also.

Elsewhere on these pages we call attention to the matter of inventions. There are plenty of things that need inventing, and many manufacturers are looking for new non-military items. What? Well for one, most people are embarrassed when they start to nod during lectures, visits and sermons. How about a small tilt-type mercury switch taped under one's chin that actuates an electrical discharge-type prodder that is in contact with - well some part of the epidermis?

Such devices might generate some radio frequency interference, but here again another simple device would collect information from all these som no-sensors and then warn the speaker that he had better shut down soon.

There are other examples of what we can include on this Club News section. Here you may be able to blow off steam. Sometimes gripes get useful operations under way. Contributions under the heading of GRIPES, OR... GRUTCHES, GLAIKES, GREMLINS and GLOMMOX are acceptable.

1909



1964

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# 55th Anniversary Banquet OF The Radio Club of America, Inc.

November 20, 1964.

Friday

AT THE

## SEVENTH REGIMENT ARMORY

PARK AVENUE AT 66th STREET, NEW YORK CITY

### STAG — INFORMAL

Timetable: Refuelling and warmup, 6 P. M.

Take-off: 7:30 P. M.

### AWARD of the ARMSTRONG MEDAL



Five years have passed since the gala event that marked the CLUB'S first half-century of activity. The Directors have asked that this year's Banquet should be equally notable. Each year this banquet is recognized as the one place where you can meet old friends and make new ones.

The Radio Club of America has always attracted individualists and independent researchers who pride themselves on personal achievements. Appropriately therefore we have secured an outstanding speaker who will comment on individual initiative: Dr. John R. Pierce, Executive Director (Research) Communication Principles and Communication Divisions, Bell Telephone Laboratories.

Theme: THE PLACE FOR THE AMATEUR

SCIENTIST IN TODAY'S TECHNOLOGY

Dr. Pierce directs some of the outstanding developments of this age, utilizing abilities of the largest group of scientists, probably in the world, with almost limitless facilities. That he knows the value of mass attack on gigantic tasks is evident. But his versatility and personal inquisitiveness is also well known as he works in all sorts of quasi-technical matters on his own. A graduate PhD, California Inst. of Technology. He has been editor of the Proceedings of the IRE, and has been on its Editorial and Executive Boards, and has won the Morris Liebmann Memorial Prize, Stuart Ballantine Medal, and other awards. He will point out where and how individuals still have a place in the modern scheme of things.

The two awardees receiving the Club's Junior Achievement Awards this year will be our guests.

By careful planning and by covering part of our normal expenses in special ways, we are able to announce a price

\$ 6.00 per ticket, for advance registrations. However facilities are limited and last-minute admissions at the door may not be possible. Tables for ten can be arranged. As is usual, registrations from non-members are welcomed.

Master of Ceremonies: ROBERT FINLAY

Edgar H. Felix, Chairman

Ernest Amy

Ralph R. Batcher

W. G. H. Finch

Harry Houck

Lloyd Jacquet

R. H. McMann

THE RADIO CLUB OF AMERICA  
11 West 42nd St.,  
New York 36, N. Y.

## MUSEUMS

One of the important operations that the Radio Club can easily attend to, is that of insuring that early historical items dealing with documents of various types and apparatus are not thrown out. The growing interest in collecting early wireless equipments calls attention to a very interesting type of hobby. It is engaging the attention of many. This series of Museum reports show such efforts in many locations. This report is the second. Incidentally, the publication of the Raser photograph up-side-down in the last issue with the note "how many items can you identify" was unentirely unintentional (you figure it out). The comments by our fellow member, Wayne Nelson, following, points out some of the pleasures of collecting "antiques" in this field. Many of us have accumulations covering many years -but these are not museums. Careful researching and authentication is needed, and proper care. Whenever members of the Radio Club feel they can no longer hang on to some things they have, please get in touch with the Chairman of the Club's Archives Committee Chairman, presently Mr. Harry Houck, (with Measurements, Inc. see adv. for address). The committee will follow through and treat the material right, arranging to give it a home in some museum where it will be appreciated, with full recognition to the donor attached to it. Anyway, let's note Wayne's comments on his own efforts.

Ralph R. Batcher.

A radio museum collection is just as much "alive" as the researched information and historically supporting facts permit. However, being too objective in collecting retards growth. Plain luck gave Nelson a good start. Many of his original books, catalogs and some equipment from about 1914 were kept over the years. In 1936 his bookkeeper gave him a package from her father's effects, including an early coherer-decoherer. The DeForest RH-4 detector cabinet and 1908 Hudson filament tube, was on the shelf of a well-known college lab, when the professor decreed a "cleaning out". They came perilously close to being permanently lost. A small 1911 E. I. Co., Navy type tuner has an untuned secondary. A note with a double slide tuner, "this is my pride and joy, please give it a good home", indicated a feeling of relief when cherished keepsakes were in hands of someone having a sense of custodial responsibility. History of many pieces intermingle tears and thrills of a Bygone life. For instance, The Radiola semi-portable super-het was the personal set of a man paralyzed from childhood, and who depended solely on this set and on photography for diversion. Some items have a strong flavor of law enforcement. A transmitting tube is a memento of Radio Inspector participation in Volstead Act enforcement, in the "Roarin' Twenties". An illegal transmitter in a coast-side barn was directing an off-shore rum-runner. The operator was overpowered before he could warn the whiskey-laden ship. The Inspector used their secret code to direct the liquor boat to within the 3-mile limit, captured. Next day a former U. S. assistant attorney general, counsel for the liquor boat, called on the Inspector, laughingly chided him "We'll have that back within 24 hours". "Yes," the Inspector replied "I know you've been getting them back, but this time I set up your shore transmitter in my hotel room and made contact with an amateur in Ohio, telling him he might be called as witness in a court case. I can prove that the signals crossed state lines, making it a Federal case. Now, do you want to go to court?" The attorney, made no further protest, forfeiting boat and car-

Other antiques may claim close Presidential association. Several of the WE tubes used in the transmitter and receiver of the USS George Washington that carried President Woodrow Wilson to and from the Versailles Peace Conference are in the W4AA collection.

Another antique bespeaks adventure, the adventure by which Admiral Richard E. Byrd directed opening up of the Antarctic. In 1934, the Admiral, alone, manned the Boling Weather Station, over a hundred miles from main base. Attempting to conceal his serious illness from heater fumes, his faltering voice gave away his plight and a rescue team rushed to save him. The original microphone used in his weather outpost is in Nelson's collection.

A retired West Coast dentist a few years ago, researching early calls, was furnished complimentary copies of the 1914 call book pages. A tender note later from his wife returning the copies, told how her husband, in his eighties, had enjoyed his hobby, had passed on. She was sure that his active interest had served to lengthen his earthly sojourn. What more beautiful though would any man hope to have his wife express after his passing? Some fine pieces are definitely not in the W4AA collection. About five years ago a long time amateur passed into the next realm, his loving wife does not permit anyone to touch his gear. She prefers to think of it just as it was while he enjoyed it, and can often imagine him still sitting there "hamming". Such are the blessings that being a true ham can leave as his legacy, but only when advance preparations are made as to disposal.

A rare find was a 100-year old American Telegraph Company message printing weight-wind "Register". Others include a 50-year old Marconi 101 receiver, an SE-143 tuner, several pieces of the loosely referred to IP500 series receivers, tuners and load coils, a 1916 Paragon tuner Grebe sets, Chambers 1916 15,000 meter tuner, 1915 Mignon tuner, Solid brand headset, pair hot wire antenna meters, Benwood and Bell rotary spark gaps, Clapp-Eastham and Thordarson 1-kw spark transformers, telefunken helix, and Marconi helix with adjustable arc gap.

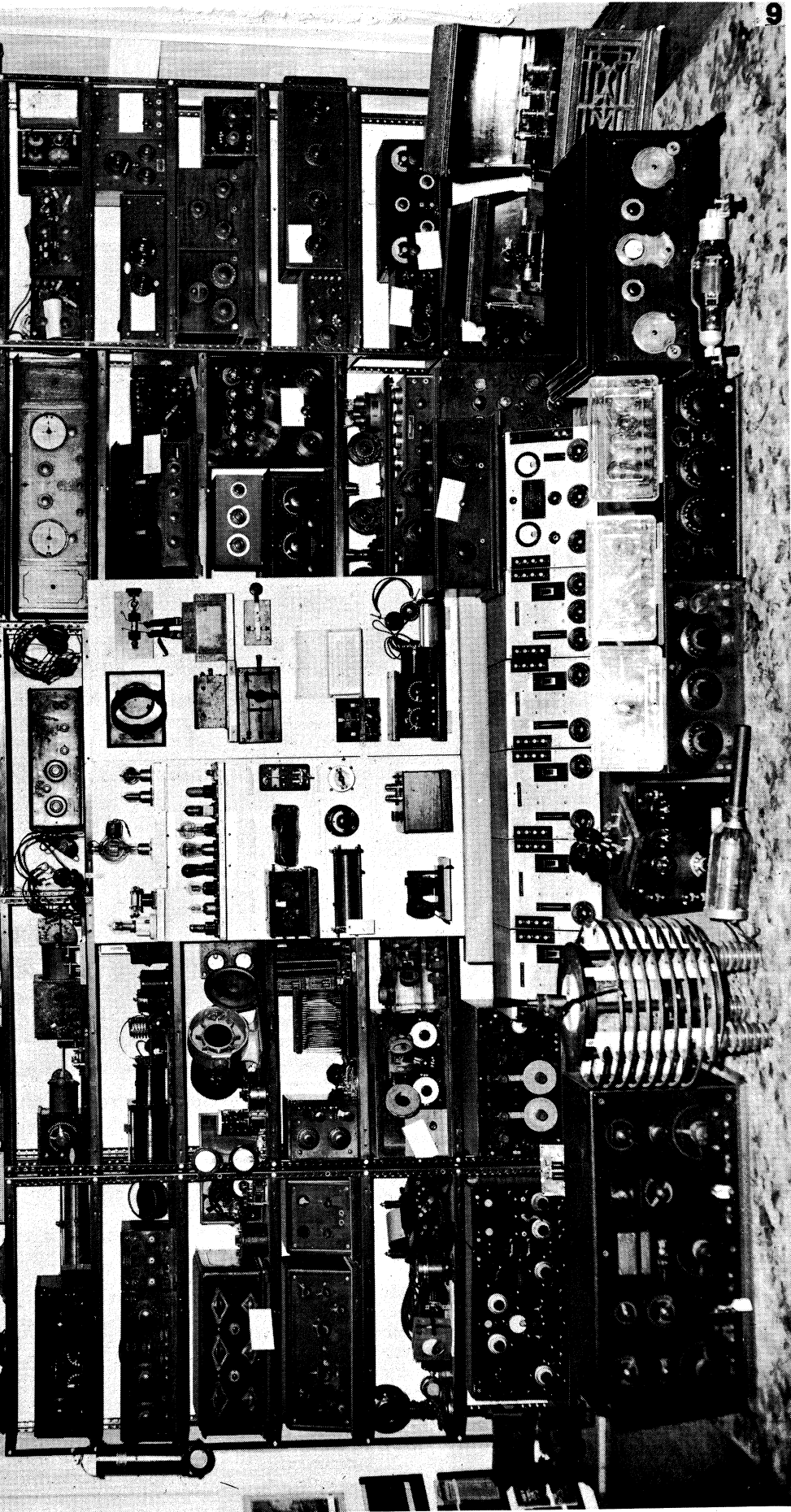
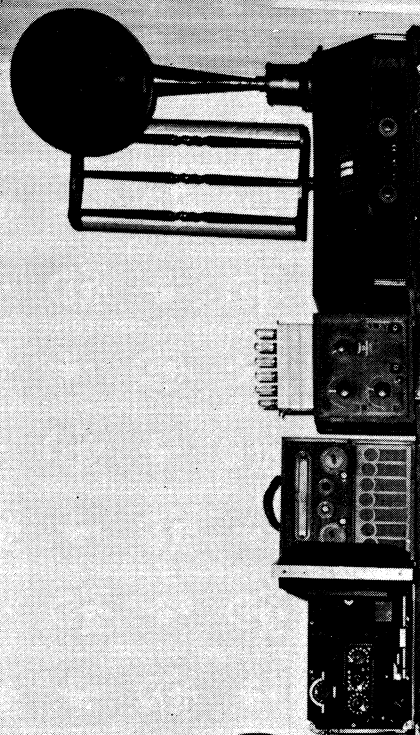
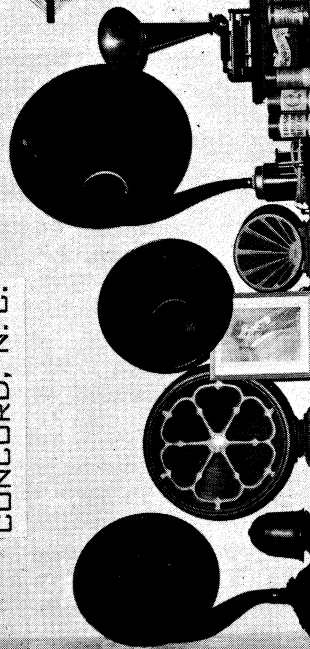
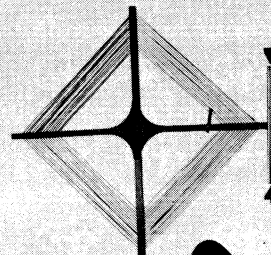
The library is the right arm of the collection. It contains a 100% complete QST file of originals, the same of CQ, and hundreds of other valuable publications. Gernsback's magazines begin with Modern Electrics, 52 issues between January 1909 and September 1913., 83 of the 87 published issues of Electrical Experimenter, some ten early call books and lists, several Tesla books including one used in a patent lawsuit and formerly in the Clark and Farms collections, a 1900 Bunnell catalog in which is listed wireless sending and receiving sets, as well as more than sixty other catalogs.

Nelson's collection is housed in an extra 9-room residence that is not required for family living quarters. While it is not open generally to the public, he gladly makes appointments by mail to welcome any interested visitors. He is not a dealer and sells nothing acquiring only to retain indefinitely in the collection. A complimentary information list (mailed to anyone requesting) has ten pages closely spaced listing the various items and publications. Publications are not available for loan but information from any library number will be furnished if the requirement is not too voluminous. The W4AA collection is a modest one. Little effort is made to "restore" any item. Why try make a "Granddaddy" look like a "teenager"? He cleans and cares for each unit in an effort to prevent further excessive deterioration, using dehumidification equipment in needed seasons. No attempt is made to exact gruelling and competitive performance from veteran gear which has earned a right to rest in dignified peace. Some of his own original equipment, books, have been paid for some, others added were acquired as early as 1914. Modest prices have been paid for some, others added thru generosity of warm hearted friends, willing for their keepsakes to find a welcome home alongside other proud pioneers of service.



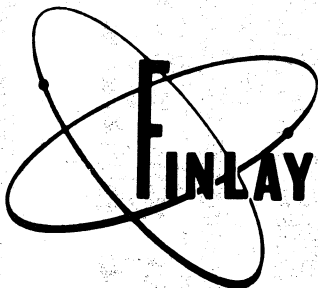
WAYNE M. NELSON

CONCORD, N. C.



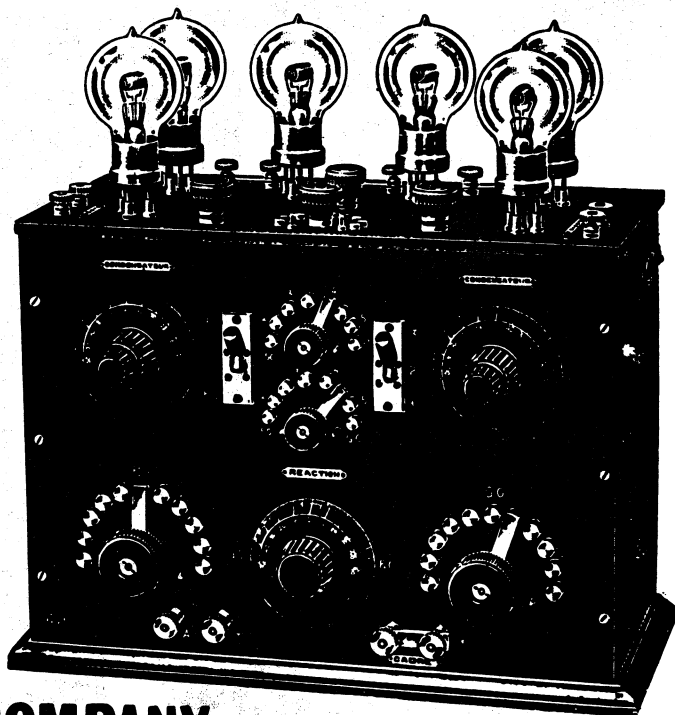
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## Planning

Several dozen of our long-time officers and members were personally queried by your President recently about their own ideas as to how the Club can engage in realistic activities, new services and augmented old ones that will up-date our operations. Replies are coming in rapidly, and a complete analysis will be made soon by an ad-hoc Committee, that will tabulate the suggestions and put them before the Directors.

Meanwhile we will welcome any suggestions from other members as to things that should be looked into. Send them in to Headquarters, in care of the President. Competition is keen among technical associations, and among publications, and we want to give the members service in any useful operations that are possible. A good time to start would be in 1965, so what do you suggest?

Elsewhere your Editor, Edgar Felix, has proposed a more elaborate program of editorial material involving many subjects that are not technical in nature, but involve other problems touching engineers role in today's operations. It is not necessary however to wait for the implementation of some such program as he proposes, to utilize a page or so of this publication to air views on these matters.

*President*  
Ralph R. Batcher

## Newsbrief

FORMER CLUB MEMBER

### Reinartz Dies

SF Chronicle 10-6-64

John L. Reinartz, a pioneer short wave radio inventor and experimenter, died at the Fort Ord Hospital yesterday. He was 70.

Mr. Reinartz, a radio ham since 1908, was credited with the invention of a short wave tuner that was the predecessor of most modern ham radio equipment. He held, along with the Radio Corp. of America and Eitel-McCullough Inc., 28 patents, some of them still in use.

Mr. Reinartz was born in Krefeld, Germany, in 1894.

Three highlights of his career occurred in the 1920s:

- In 1921, he invented the Reinartz tuner, which was to serve as a model for almost all short wave tuners since.

- In 1923, he took part in the first two-way trans-Atlantic short wave radio communication.

- In 1925, he served with the Byrd North Pole expedition as chief of communications.

Mr. Reinartz is survived by his wife, Gertrude, of Aptos.

Funeral services will be held Friday in Santa Cruz with burial at the Golden Gate National Cemetery in San Bruno.



# BANQUET

## Nov 20th

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STAG — INFORMAL

**Speaker**

THE PLACE FOR THE AMATEUR SCIENTIST IN TODAY'S TECHNOLOGY.

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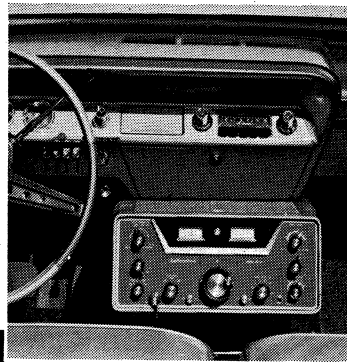


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**General:** Dial cal., 5 kc.; 100 kc. crystal cal.; VFO tunes 500 kc.; 18 tubes plus volt. reg., 10 diodes, one varicap. Rugged, lightweight aluminum con-

struction (only 17½ lb.); size—6½" x 15" x 13".

**Transmitter Section:** (2) 12DQ6B output tubes. Fixed, 50-ohm Pi network. Power input—150W P.E.P. SSB; 125W CW. Carrier and unwanted sideband suppression 50 db.; distortion prod., 30 db. Audio: 400-2800 c.p.s. @ 3 db.

**Receiver Section:** Sensitivity less than 1 uv for 20 db. signal-to-noise ratio. Audio output 2W; overall gain, 1 uv for ½ W output. 6.0 — 6.5 1st I.F. (tunes with VFO). 1650 kc. 2nd I.F.

**Accessories:** P-150AC, AC power supply, \$99.50. P-150DC, DC power supply, \$109.50. MR-150 mounting rack, \$39.95.



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