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PROXIMITY FUZE

Secret Weapon of W.W. II

Much has been written about radar and its effect in winning World War II. Little mention has been made of the proximity fuze, which may have been equally important. In totally paralyzing the enemy air force, it made the Pacific an American instead of a Japanese lake and gave us complete superiority in that theater of war. Its effect in neutralizing the "buzz bombs" as soon as it got into action in the London area, and later at Antwerp, was decisive, and when it was released on the European front it not only wiped out opposing air forces, but destroyed the morale of ground forces to an extent that was a great factor in bringing the war to an end.

Introduction

by Jerry Minter

The Radio Club of America published two papers in the March 1946 issue of the *Proceedings.* The first was "The Radio Proximity Fuze," by Dr. L. Grant Hector; the second, "Radio Countermeasures: the Science of Immobilizing Enemy Radar," by Oswald G. Villard, Jr. These two papers summed up the two major new electronic developments that resulted from World War II. The proximity fuze paper was presented before the Radio Club at its October 1945 meeting—only two months after the end of the war! The radar paper was presented at the January 1946 meeting.

Many papers covering the subject of radar and countermeasures have since been written. Very little has ever been added to our original story about the proximity fuze.

Our former president, William H. Offenhauser, Jr., suggested several years ago that the full story of the proximity fuze (also called VT Fuze) should be told while most of the active participants were still alive to tell it. As a result of Bill's dedication and action the following group assembled on November 17, 1978, at a luncheon meeting in the Hotel Sheraton, New York City:

L.R. (Larry) Hafstad, Ralph Baldwin, Vice-Admiral George F. Hussey, Lewis M. Clement, Harold F. Schwede, A.J. Adams, John M. Pearce, Robert Sprague, William H. (Bill) Offenhauser, Dean C. Allard and Jerry Minter.

Additional comments were made available via tape recordings from Herb Trotter, Admiral Arleigh Burke and Curry Ford.

A binaural tape recording of the entire proceedings was made by Jerry Minter and transcribed by his son, Byron Minter. This transcript was reviewed by Harold Schwede, then sent to Dean Allard of the Naval Library for review and retyping for distribution. Copies are now on file in the Naval Library in Washington, DC. The Board of Directors of the Radio Club has approved publication of the Document in forthcoming issues of the *Poroceedings.* The original binaural tapes are 4.5 hours in duration.

To minimize the costs of publication, some comments not directly connected with the fuze have been omitted in this version. Persons interested in the full record may obtain a copy of the original manuscript for $10 from the Club. Address Fred Shunaman, 933 East 7th St., Plainfield, NJ 07062, and make all checks payable to The Radio Club of America.

Recently, one of our panelists, Ralph Baldwin, has published a book, *The Deadly Fuze,* containing much information about the details of the proximity fuze. It is available from the Presidio Press, Box 3515, San Rafael, CA 94902. Price $14.95.

(Story begins overleaf)

The VT (Proximity) Fuze Meeting

November 17, 1978, at the New York Sheraton Hotel, during the Annual Conference of the Radio Club of America, Inc.

LAWRENCE R. HAFSTAD

Deputy Director of the John Hopkins Applied Physics Laboratory and in charge of security, production and quality control. Background in electronics and Nuclear Physics.

I would suggest that we begin with a brief statement of what I call the research phase, which has already been written in the book, *Scientists Against Time,* which is the history of OSRD.* At the end of the war, we all felt that we had done a good job which ought to be recorded.

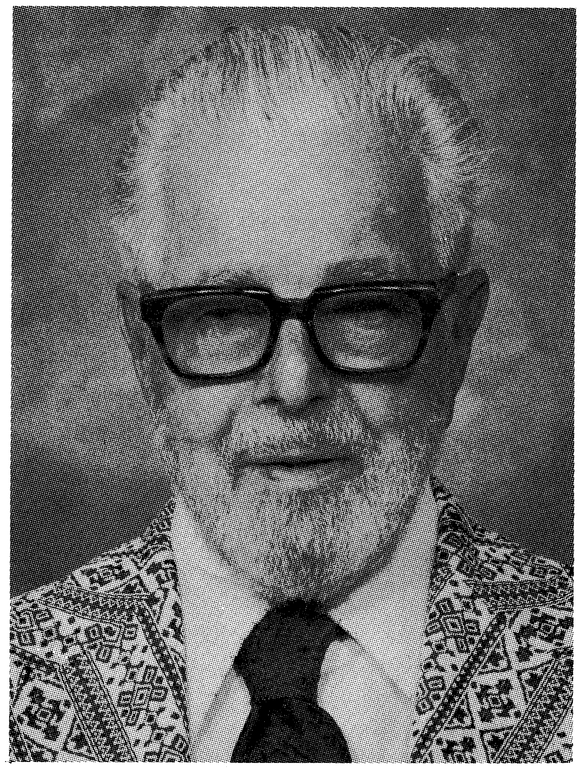
I have long been disappointed that we have never been able to tell this story in a consistent account of the whole job. Several attempts have been started at the Applied Physics Laboratory (APL), but somehow or other they all died. To date, Baldwin's is probably the best that has been provided. However, it emphasizes the Army's side and the applications. That still leaves a big gap between what I call the research phase and the very difficult and important job of getting it into quantity production, and essentially solving the Navy problem before we could come to grips with the Army problem. Offenhauser and I thought that we would take advantage of this opportunity to bring in Lew Clement representing Crosley to tell us about the difficult transition problem from research to production.

In the research phase you have great success if you can assemble devices that can be made to work. In the production phase, you have to produce devices which you can prevent from failing. That's an enormous difference, which is usually not recognized by the research and scientific people who generally collect their apparatus, tune it up, spend a lot of time working on it, take a set of readings, and get a Nobel prize. The job is done. That's just the opposite of what you do in the production cycle. So this is the reason we have tried to fill in—in the name of archives—the difficult problems that you face first in quality control, then in volume production and reliability of all the other things that are needed.

It is our hope that we can get statements here during this meeting that gradually add to it and get into the Naval archives. Then, Allard and I hope to find some graduate student in the history of science to dig through the archives, where there is an enormous amount of material—lots of statistical material. What we need are anecdotes and examples of the kinds of problems that you run into in going through this and how this particularly dedicated group somehow overcame these difficulties. I have some comments to make along this line but since we are short of time, I'll drop this here so that we can go on to the important things, which are the Crosley story and the suppliers' story. Later I can fill in gaps.

*OSRD, Office of Scientific Research and Development.

LEWIS M. CLEMENT



Vice-President of the Crosley Corporation and personally responsible for all Crosley fuze production, Crosley serving as a lead company, being the first major producer of proximity fuzes in quantity.

I think that this is the greatest example of cooperation that I have ever seen, that is, the cooperation between the technical people, manufacturing people, suppliers and users. Without this very good cooperation, the job could never have been done. As far as Crosley is concerned, we received a letter in October 1941 telling us that we would be contacted that month on a very important, Top Secret, top priority job, to determine whether or not we were capable of doing it.

On the 28th of October, Dr. Hafstad, Lieutenant Hicks and the local Inspector of Naval Material came to Crosley and asked to see the Vice President in charge of Engineering.* He told us that we had been selected because he though we had the necessary mechanical and electrical background and could undertake the job because we made electrical refrigerators, appliances and radio receivers. It was very fortunate that he came at this time because, a year earlier, the story would have been entirely different. Crosley had been completely reorganized, at least in the manufacturing side of the business, to do an excellent, high quality job. This reorganization took place over a year before Dr. Hafstad's visit to Cincinnati, which I think is important.

I think that there were many small things that happened that benefited the job. One story that I recall is that we had difficulty with a certain coil in the oscillator. It was not uniform. So we sent H.L. Brouse to Chicago to find out why. At 2:00 am—he found out—the room in which the coil was being made had opened windows near the coil forming stations. They closed the window and we had no more trouble. It's something like that that one does not understand unless one is in the business.

We undertook the job on the basis that we would first copy what they were making at section T, with the exception that all metal parts would be made from tools and all plastic parts would be made from molds. This was because we anticipated going to mass production. So, we made ten models of that type. We gave one of our research people the job of looking at the fuze, looking at all the information about the fuze, and making a comment about what he felt could be done to do a good job. The only suggestion that he made was that the antenna series capacitor should be solidly mounted. So we made ten like that. Then we made ten more using GFE** brass caps for antennas instead of the aluminum caps that we had before. We expected that we would make a change, but only if we would do at least as good a job as they did at DTM.†

The firing tests were delayed until after the first of January 1942. The first group of ten showed a ten percent score, which was about the same score that they were getting at section T. The second group, with the solidly mounted antenna, was 40 percent. The third and fourth groups gave zero percent because of tumbling and instability due to a heavier nose cone.

Another thing that we did was to figure that we must design the stuff for mass production. We had to get cooperation between engineering and manufacturing. We had to devise a system for transferring information from engineering to the factory. We set up a pilot line which was jointly run by the factory and engineering. We made things in the pilot line, and it was set up so that it would have the same operations as later on in the factory. Thus, the pilot line changed from time to time to keep up to date with the factory situation. As a result, it was very easy to transfer the stuff from the engineering phase to the production end. We used the pilot line to train operators so that, when the time came to go into quantity production, we would have several hundred operators capable of doing the job.

*They were escorted to Mr. Clement's office.
**GFE, Government Furnished Equipment.
†DTM, Department of Terrestrial Magnetism.

THE RADIO CLUB

71st Anniversary Awards Meeting and Banquet

New York Sheraton Hotel
7th Avenue at 56th St., New York City

Friday, Nov. 21, 1980

2:00 PM **COMMUNICATIONS SYMPOSIUM**

Beginning of AM 2-Way Mobile Radio
Frank Gunther, Fellow & Past President

Birth of CB Radio—How it Started
Al Gross, Fellow

Emergency Communications in High Places
Joseph Chislow, Fellow

Small Cellular Systems at 800 MHz
Jan David Jubon, PE

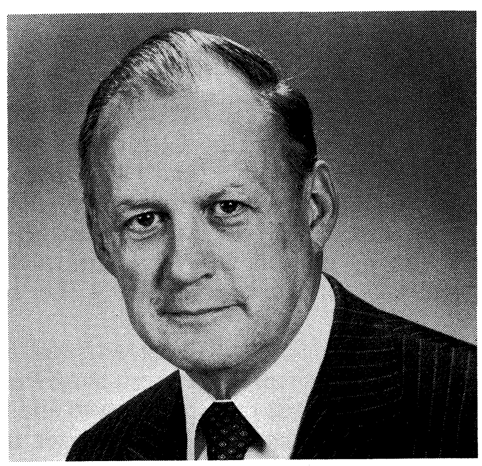
5:30 PM **ATTITUDE ADJUSTMENT SESSION**

7:00 PM **DINNER**

Banquet Keynote Speaker

ANDREW F. INGLIS

President, RCA American Communications



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Miss June Poppele, Tele-Measurements Inc.
145 Main Avenue, Clifton, NJ 07014
Telephone (201) 473-8822

The most important thing I have to say is that the project required cooperation. To get that cooperation, we issued a weekly report which covered all the work that we were doing, as well as any suggestions that we had in mind. The report was given to the Navy, to section T, and to Crosley. We also had a resident engineer living at Dr. Hafstad's place who was given no instructions other than to be helpful. In other words, he understood what was going on with us and with manufacturing. We relied upon him to keep us up to date informally. As a result, I think he was valuable not only to us but to section T as well.

I feel the security was very good because I don't know of a single case of sabotage during the entire period that we worked on the fuze. We suggested a proving ground of our own in the Cincinnati area. We went to the extent of renting farms, building roads, and getting things all set. The day before we were supposed to use it, the Navy took the firing pin away. It took me 30 years to find out why. The reason was security, and I agree completely with the Navy.

Before the end of the war, we had made about five and one-quarter million fuzes. We made forty to fifty thousand fuzes on the pilot line. We made one thousand fuzes before anything went to the production side. We had a closely knit, fully cooperative company on the job—not only among ourselves but with our suppliers, the Navy and DTM as well. Thanks.

VADM GEORGE F. HUSSEY, JR.

Chief of the Bureau of Ordinance at the beginning of World War II and the officer who made the critical decision to put the proximity fuze into production.

The Admiral began by describing his activity as commander of a squadron of mine sweepers in the South Seas, being called to Pearl Harbor just after the Japanese attack, and later to Washington, where he started to work as Director, Bureau of Ordnance:

Three or four weeks later, the Director of R&D, Sam Shumaker, an old friend with whom I had taken a postgraduate course in Chicago, came in to see me. He sat on the corner of my desk and said, "George, there's something going on around here that you ought to be aware of. It'll take an afternoon to see it. Let's go this afternoon."

We drove out to Georgia Avenue and ran into the strictest security requirements I had seen since Pearl Harbor. We had to get through two sets of gates and two sets of guards. They finally let us through. I met the most dynamic man I'd ever seen. In a very quiet manner, he welcomed me to the situation and explained in a few well chosen words what it was all about, what they were doing. He brought in several of his assistants, each of whom told me about his particular part in the process.

It began to dawn on me what was going on. Like most of my contemporaries, I had at one time or another knocked a radio set off the corner of my desk. I picked up a pretty sorry mess from the floor and put it in the waste basket. Here were these eminent scientists trying to put a radio set in the nose of a projectile which they claimed would think for itself, go off and get where it should. By the time they turned on the projector, my eyes were fairly sticking out of my head. They showed me the *Cleveland* firing — one drone, one shot, no drone; second drone, one shot, no drone; third drone, one shot, exercises completed, no more drones available. I thanked them for their hospitality and all the information they had given me. Sam and I went back to the Bureau. A couple of days later, he came down and said we ought to go see where they make those things.

We went to Cincinnati to the Crosley plant, which I had never seen before. My recollection of it was of a crowded area with a great many buildings, in the middle of which were two or three relatively small buildings. They were quite undistinguished with no special markings on them at all. We were taken into the first one and shown a production line beautifully laid out and running extremely smoothly with no chatter from the operators. The supervisors exercised very close supervision, and only the people at the end of the line knew what the product of that line looked like. That went on to another line, more things were added to it. From there it went to another building where the first product was augmented by more bits and pieces until finally, at the end of the line, there stood a VT fuze.

I didn't know what it was when I first looked at it, but what intrigued me about the whole thing was the massive security—never a reference to the fuze anywhere—and the concentration by the workers and the supervisors such as I had never seen before at any production plant. Then our host at the plant, Mr. Clement, gave us more information on the troubles they had run into, how they got around those problems from a production standpoint, and how they worked together with suppliers to modify components as required to come up with a finished fuze. He gave a clear picture of how much this project meant to the company and to the country. After that, Sam and I went our separate ways.

While travel money then was relatively easy, travel time was not so easy, because you spent more time away from your desk. We always tried to get in as much travel as we could on any particular trip. It was three or four days before we were both back at the Bureau. Then Sam came by once again and said, "George, I think that project's about ready for production." I said I agreed. He said, "Okay, we're out on a limb for 85 million dollars." That how I got involved in the VT fuze business.

ROBERT SPRAGUE

President of the Sprague Electric Co., who accepted the challenge of producing by the millions the critical high-quality components that were essential to the success of the fuze.

Sometime in the Fall of 1942, I got the most unusual telephone call I have ever received. A lady, who identified herself at Lt. Sally White of the U.S. Navy Bureau of Ordinance, referred to a lot of six samples, which she identified by number, and which sometime earlier had been sent to the Applied Physics Laboratory of Johns Hopkins University. She requested that I furnish her at the earliest possible date:

1. The cost of having facilities for the manufacture of 30 million very slim, unencapsulated paper capacitors per year, which we were to call "Toothpick" capacitors. (Towards the end of the war, production of these had been built up to about two million a week.)
2. The time when we could start to manufacture and the rate at which we could build up production.
3. She also asked for similar information on a much smaller quantity of annular, (ring-shaped) capacitors to be used in the same equipment. These were to be furnished at approximately 12 percent of the "Toothpick" requirements.

Imagine my surprise! I had never heard of anybody using 30 million capacitors a year and didn't have the slightest knowledge of the particular samples to which she referred.

I called Dr. Preston Robinson, Director of our Research and Development Department, and asked him to identify the sample lot referred to by Lt. White and then to come to my office to talk about any problems we might incur in furnishing them. It turned out that the capacitors were indeed of unique design and manufacture:

1. Three types of capacitors were to be put into production. Two of these—one of which was by far the largest volume item—used processing materials never to my knowledge previously used in capacitors. The largest volume item, the "Toothpick" capacitor, was to be impregnated with a monomer of vinyl carbazole, and polymerized in situ.
2. The largest volume annular capacitor—and I believe we were the sole source of this particular unit—also used specially treated cellophane film as the dielectric, instead of thin capacitor tissue, and was also impregnated with vinyl carbazole.
3. The third unit was another annular. It used paper capacitor tissue, impregnated with a chlorinated wax, as the dielectric.

As the capacitors were required to withstand a shock of 20,000 G's, a number of dielectric systems were tried during the development, with the final results I just mentioned.

Dr. Robinson told me that he became familiar with the German development of the polymer of vinyl carbazole prior to World War II and, for reasons which I do not recall, had purchased a small supply of this material from Bayer, just prior to our entrance into the war.

One problem we were faced with immediately was that there was no American manufacturer of vinyl carbazole. It appeared that we would have to set up for its manufacture. And chemical manufacturing was a completely new undertaking for the company!

We go into chemistry

One of our chemists, I believe Dr. Lester Brooks, worked with DuPont to develop a process for its manufacture. We constructed, at the Navy's expense, a small manufacturing facility.

We had to design and erect a special building located behind our Brown Street Plant in North Adams, Massachusetts, that was required to withstand an internal explosion because of the fear that a runaway reaction might occur. The acetylene gas to be used in the process was under pressures in the neighborhood of 500 to 600 pounds per square inch! When the plant was finally ready for production, we produced only 300 pounds in the first run, which was a successful one. Then vinyl carbazole became available from the General Analine and Film Corporation. This was the new name for the Agfa-Ansco Corporation, which, like the Bayer part of the German I. G. Farben trust, had been seized by the Treasury Department and renamed. This company, which the Government sold after the war, is now known as the GAF Corporation.

The special building, however, was not a complete loss as it and much of the equipment were used to impregnate capacitors with vinyl carbazole until the time when new and special impregnating facilities were designed, developed, and installed in our Marshall Street Plant in North Adams.

Impregnating the capacitors with the monomer of vinyl carbazole posed problems that were new to Sprague Electric and to the capacitor industry. Freezing of the impregnant in our piping was one problem. In the early stages, small impregnators with a basket size of 8" x 10" were used. The impregnating temperature of 85° C. had to be very accurately controlled, and I mean *much* more accurately than other types of impregnants required. The Mayor of North Adams, Faxen Bowen, who also worked for us during the war, was responsible for a freeze-up of an impregnating tank! There were electrical or static spark hazards, and the material was extremely toxic and caused dermatitis.

The new facilities installed in our Marshall Street Plant had even more accurate temperature and humidity controls than those just mentioned. Also I believe that for the first time we took steps to control the dust particles in the air. Periodic medical tests were required for all operators. The manufacturing area was complete with showers and locker rooms.

We also had a problem with the cellophane that was required in one of the annular capacitors. The commercially available cellophane was not a good dielectric. It contained plasticizers which impaired its electrical properties. When we developed a process to remove the plasticizers, the cellophane became brittle and could not be wound satisfactorily. Then we had to develop a supplementary process to soften the de-plasticized cellophane so that it could be wound into capacitors.

A hand-crafters triumph

As our automatic rolling machines could not handle the very small diameters of the "Toothpick" capacitors, it required an enormous number of operators to man all the hand-winding machines needed. Although I don't remember the total number of hand-winders, I am advised that Paul Netherwood, now retired but then one of our senior engineers, remembers that at A.G. Spalding in Chicopee, Massachusetts, one of our subcontractors, there were one thousand hand rollers! We had an additional subcontractor at the Rock of Ages Corporation in Barre, Vermont. However, all rolled units were returned to North Adams for impregnating with the monomer of vinyl carbazole or wax.

Our records indicate that toward the end of World War II about 4,800,000 "Toothpick" capacitors a week were shipped by seven manufacturers. Then, with the Sprague shipment of two million a week, it appears we were supplying about 42 percent of the industry's requirements, and we were the only one using polymerized vinyl carbazole as an impregnant. I believe that our product was shipped to five Navy contractors: Eastman Kodak Co., The Hoover Co., Baldwin Piano Co., McQuay-Norris Corp. and Crosley Corp., and were also probably shipped to others by our competitors.

On September 26, 1945, the company was one of 32 firms selected to receive the Bureau of Ordinance "E" Award out of some 1,000 engaged in what became the Navy's most important secret weapon, the VT fuze. At the height of our production, 2,600 of our employees and employees of our subcontractors were engaged in this program. I don't think it improper to mention that prior to this award the company had received four Army/Navy "E" Awards for excellence in war production.

After the end of World War II, our production of capacitors for the Navy VT Fuze continued for ordnance stockpiles. During this post-war period there were also some changes in the design of the units, the ultimate being small hermetically-sealed units, which were designed for not fewer than 20 years' storage before use.

It is also appropriate for the records to note the names of key Sprague personnel involved in the design and manufacture of the special capacitors. Dr. Preston Robinson, our Director of R&D at that time, made the largest initial contribution. He was assisted by two of our senior engineers: Paul Netherwood and Mark Markarian. Robert Teeple was responsible for the manufacture of both the annular and "Toothpick" capacitors. Edward Goodman and his staff developed much of the special equipment and production processes. As earlier mentioned, Dr. Lester Brooks, with the assistance of DuPont, developed the process for the manufacture of the monomer of vinyl carbazole used as an impregnant.

CURRY C. FORD

National Carbon Co. Since Mr. Ford could not attend the meeting, this recorded message was made November 16 at the home of Bill Offenhauser in New Canaan, CT.

It was only a few months ago that I learned that Bill Offenhauser knew my good friend and former business associate, Dr. Laughlin M. Currie. Dr. Currie was formerly Vice President of Research for the National Carbon Company, the developers and manufacturers of the reserve battery used on the VT Proximity Fuze. In the course of our conversation about Dr. Currie, the subject of the proximity fuze came up, and I recalled an unusual breach of security that occurred at the National Carbon battery plant in Cleveland.

It seemed that a classified part stuck to the shoe of one of our people. I believe it was Dr. Duncan Gage. It was carried out onto the street in front of the plant. Fortunately, it was found by one of the project members, and security was preserved. You can imagine my surprise when Bill Offenhauser said, "Yes, I know. I'm the one who found it."

This coincidence led to reminiscing about many of my former associates at the National Carbon Company who were very much involved in the development and production of the reserve battery. Bill invited me to attend today's historical review, but I regret that a last minute conflict prevents me from being with you. Although I was not personally involved in the proximity fuze program, I am well aware of the important part my company played in it, and know it would have been rewarding for me to attend.

Several weeks ago, Dr. H.G. McPerson, formerly Assistant Director of Research at National Carbon and retired Associate Director of the Oak Ridge National Laboratory, was my house guest. When I told him of my plans to attend this review today, he recalled an initial feasibility test that he conducted on the battery. He said that when National Carbon was asked if the battery could withstand a force of 20 G's, he placed a battery in a steel shell, packed it in sand, and dropped it down a stairwell at the laboratory. He had calculated that the resulting impact would produce the required 20 G's. The battery was not damaged, and I believe this was the origin of the sand-packed concept.

Some time after Dr. Currie retired, I became the Vice President for Technology of the Carbon Products Division of Union Carbide, the current designation of the old National Carbon Company. Several of the scientists and engineers in my group had worked on the proximity fuze battery and often recall with pride this outstanding technological achievement and exciting experience. Most of them, like me, are now retired. However, I'm sure that all of them wish they could be here with you today and share in the recording of the historical highlights of the development of the first "smart" fuze.

A. J. ADAMS

Plant manager at National Carbon, reporting to A.V. Wilker and responsible for the production of the millions of high-precision, high-quality batteries for all the various fuzes.

In November 1940, a man walked in and said, "Gentlemen, I want a battery that I can fire out of a gun." We said we'd be glad to give him the address of a reputable battery manufacturer up the street. He didn't listen. Our President, with two projects behind us that had been completed in a matter of months, said, "Yes, sir, we will give you the battery."

Back to the mines we went. Fortunately, the second process had been developed and could again be miniaturized. We had told our own sales department, "Don't ever come back for anything smaller than this because that's out." Here we were now trying to come up with a 2-inch battery with so much voltage. Then we were told they also needed a 1.5-inch battery. Wow! We had to cut our minimum size cell in half to get two inches; then we cut it by five-eighths to get 1½-inches. That five-eighths was a trapezoid, and if you don't think it's fun to handle material in a trapezoid shape! Anyway, by the middle of 1941, we were delivering batteries to section T for their own experimental work. At once, Mr. French and the rest of us realized that this battery never could function in the field with the logistics that were involved. We knew we were having trouble with it even in radio sets.

The reserve cell breakthrough

Mr. French started thinking, and, by the early part of 1942, he came up with the reserve cell* concept. This was a brilliant development on his part because our Le Clanché experience actually had nothing to do with the development of the reserve cell. It was a completely different animal, plus the fact that the reserve cell depended upon setback and spin to activate it. How in the hell are you going to test your product in the laboratory? We couldn't set up a gun in the lab. Not only did we have to develop the battery, but we had to have some means to simulate the action of a gun. We developed very high speed spinners with methods of breaking the ampule before we could make any progress in the development work. Here we were with two pilot lines running in the development laboratory—one still running on the minimax, the other one running on the reserve cell. This was at the start of 1942.

*A cell in which the electrolyte is contained in an ampule that breaks when the gun is fired. Thus the cell remains inactive until used—has an indefinite shelf life.

By October 1942, I was sent to the Bennington plant to set up the first half line production with production equipment. We had actually started before the production contracts of late 1942 because we had to furnish the batteries for all the testing. At Bennington, we started the half line in November 1942. I can remember the day I said to Gene, "We've made 20 units the best way we know how." We sent them for testing, and I told Gene to call me as soon as he got the results. He called me. Twenty were tested—20 failures. That was our start at Bennington. Anyway, things got better; they couldn't get worse.

In the meantime, we had received our major prime contract, and the Winston Salem plant had been procured. Production equipment had all been ordered. On April 1, we moved to Winston Salem. We had trained personnel at Bennington, including the naval inspector who I insisted be trained with our own people, which was a godsend later. We opened up the Winston plant on April 1, 1943, and got going. Our battery was known as the NC2. The ABC section of that battery was called XYZ. ABC was never used anywhere in the plant or by any of our people. The X was the A, the Y was the B, and Z was the C section. As we started, it was impressed upon us: miniaturize, miniaturize! The minute the NC2 was in production, we started miniaturizing.

In 1944, Mr. French was ready with the NC6. The Navy decided we had our hands full. They brought in Eastman Kodak who took our battery design, engineered it, and put it in production while we were building an addition on our plant in Winston Salem. Actually, they swung into production ahead of us, but there was the most beautiful liaison that you could imagine among National Carbon, Eastman Kodak, section T, and the Navy. How two firms that had not worked together before could combine in a single endeavor as we did with Eastman Kodak is almost unbelievable. It went more smoothly than anybody could have imagined. In 1944, we opened the Bingham plant. As soon as the NC6 was in production, Mr. Frendh went back to work.

By early 1945, it was evident that the NC8 was really getting small and had possibilities. In January 1945, I was sent to Buffalo to open the Buffalo plant, which was going to make two lines of NC6's and one line of NC8's. We hired our first production workers on August 3, and we were terminated on August 10, not knowing the end of the war was August 15. It was an awful blow to us during those four or five days that we suffered unaware of the end of the war. It was a story of the cooperation and the adaptability of the whole radio industry. We had some training whose purpose we didn't know, but it really came in handy. Thank you.

ADMIRAL ARLEIGH A. BURKE*

The famed "Thirty-one-knot-Burke" of the Cape St. George action in the Solomon campaign. He was a user of the fuze in combat throughout the war, and rose through the ranks to become the top Admiral of the Navy, and in due course head of the Joint Chiefs of Staff.

*This presentation was made from a pre-recorded tape—Admiral Burke could not attend.

Admiral Arleigh Burke

Dean Allard has told me that all the people involved in conceiving, inventing, designing and producing that wonderful VT fuze during World War II are now gathering together to find out how they did that wonderful and magnificent job. He also told me that my good friend, Larry Hafstad, is the moderator for this interesting occasion. If Larry does as good a job on this as he did when he ran the Research and Development Board, you will all have an exhilarating time. Furthermore, it will be worthwhile.

During the Solomon campaign in the South Pacific, I was in command of various units of destroyers. It was a rapidly changing and very hectic situation. The ships that were assigned to me were frequently changed because ships were being sunk, ships were being damaged, and the crews were becoming very tired. As a result, there was a drastic shortage of those fine fighting ships in that area. Dean Allard has asked me to explain the use of those VT fuzes in action. For the life of me, I cannot now remember which outfit I had when Deke Parsons came out with boxes of VT fuzes and asked if we could use them in my outfit. Of course, we were delighted, for I knew that anything Deke Parsons recommended had to be good. I think I was in *Conway* at that time, but I know I was commander of destroyers operating in the slot or, as we called it, COMDESLOT for short.

In any case, Deke came to that outfit because we quite frequently had a lot of night action. We had had encounters with enemy aircraft, barges, destroyers, and we were always expecting larger ships at any time. We fitted one division of DESLOT with VT fuzes which were to be used on orders as directed by Deke. We went up the slot looking for plenty of action.

As you all know, that is the time that the enemy never cooperates. However, about the second or third night out, enemy aircraft snoopers were picked up. Deke said, "Now is the time. Snoopers are better than nothing."

(Continued in our next issue)