RESEARCH REPORT
1949

Prepared for use by engineers and executives
of RCA divisions and companies in
planning the development of
products and services

RADIO CORPORATION OF AMERICA
RCA LABORATORIES DIVISION
PRINCETON N.J.

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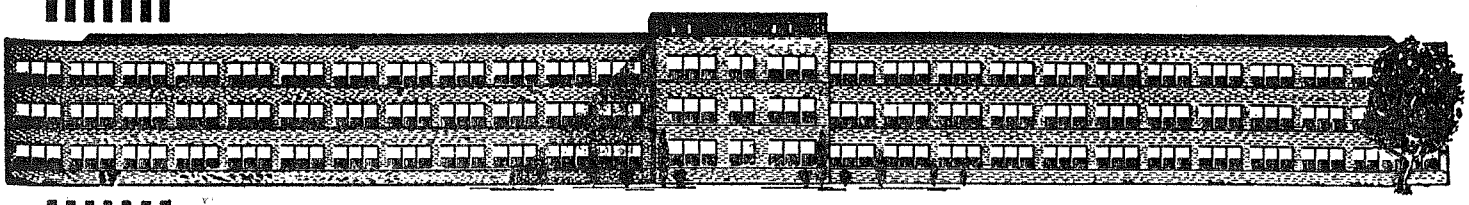

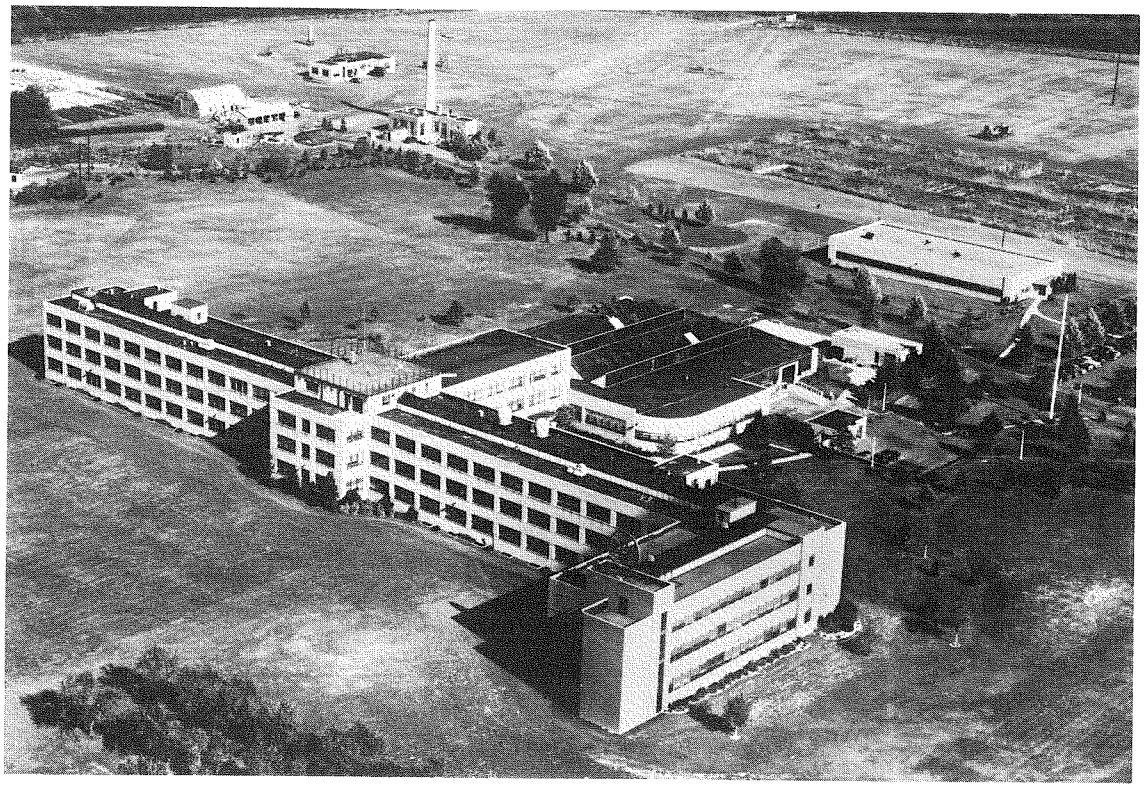

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Television was the prime interest of radio manufacturers and broadcasters during 1949. This remarkable expansion, however, progressed under the cloud of the "freeze" order of the Federal Communications Commission. The "freeze" order beginning October 1, 1948 continued in effect through 1949 and the end is not yet in sight. To the "freeze" order with its VHF allocation matters and expansion into the UHF region, the Commission added during the year the color question.

Late during 1948 we conducted tests on synchronizing the picture carriers of television stations. Early during 1949 we successfully demonstrated the "offset-carrier" method of co-channel station operation, and this simplified process has since gone into practical use. This development and our proposal of it was significant because it provided the basis which could have been used in lifting the freeze (offset-carrier resolves the question regarding co-channel interference). We have since related "offset-carrier" operation to color and to black-and-white television, demonstrating that the conditions are the same as regards allocation matters.

In order to obtain more practical information on UHF television, plans were made and construction completed of a transmitter for field-test operation at Bridgeport, Connecticut, rebroadcasting WNBT channel four programs.

In its public notice of July 11, 1949 (revised July 28) the Commission scheduled VHF, UHF and color television for hearing starting September 26, 1949.

We had continued our work on the simultaneous color method but late in 1948 concluded that because of potential channel scarcity, color should be reduced to six-megacycle requirements. Based on earlier concepts we were ready to proceed with the RCA color system which is a six-megacycle, high-definition fully compatible system.

Accordingly, we proposed this method at the opening of the hearing and at the same time initiated a field test in Washington of the RCA color system. Two sets of demonstrations were given, one during October and the second of a comparative nature during November. As was to be expected we experienced the growing pains of a new system but work in the laboratory and in the field resulted in resolving what we consider to be the basic problems by the year end. Ahead lie additional problems of performance refinement, apparatus simplification, proof of performance and proposal of specific operating standards. Our plans for all this are laid.

The year was a busy one in licensee assistance and contacts. Primarily this was because of the rapid growth of television receiver production. Upon completion, late during 1948, of Industry Service Laboratory facilities in Princeton, a large scale licensee visit was planned and this took place January 11-14, 1949. With the main Industry Service Laboratory facilities in New York, with the provisions for research-to-development status transfer by the new group and new facilities at Princeton, with the tube measuring and standardizing laboratory at Newark, with the branch laboratory in Chicago we are in excellent position to serve the licensees in all but the West Coast area. This matter of better serving the West Coast licensees is under study at present.

Late during 1948 we established a program of sponsored advance development in the RCA Victor Division. The work program objectives were those considered to be of interest to our broadcast-receiver licensees. This activity continued throughout 1949. The work was, however, altered somewhat and increased so as to contribute directly to the color television situation. As a part of this sponsored activity, a UHF television transmitter was completed for field test operation at Bridgeport, Connecticut and an appropriate group of tuners and converters were constructed for television receivers.

While the television problems engaged our major attention during the year, we continued to keep a reasonable balance for other activities. This is true for both fundamental research and applied research. In the field of our fundamental work we are building stature and at the same time directing attention toward useful ends. The need for basic foundations upon which to build our applied research programs becomes clearer as we proceed. Our fortunate situation of having personnel, facilities and backing to engage in an appropriate amount of fundamental work is becoming important in the continuing strength of RCA research.

We have continued our studies in the field of electronics of solids and the related conditions for electron emission common to nearly all electron tubes. We have made progress on the crystal amplifiers not only in research, but through our sponsored advance development program, in the making of the devices and their practical application.

Following the war we established laboratory facilities and a program of research on gas-discharge devices. This activity bore fruit during the year both in improving our understanding of certain gas-discharge phenomena and in practical results in the form of improved tubes.

We have underway, now with a considerable background of experience, a program of instrumentation research related to nuclear physics. To this will be added next year studies of conduction at low temperature. This work is being done under government contract.

Work done for the military services under contract continues, slowly increasing in magnitude. There is a tendency in these programs of work toward basic studies and longer term objectives rather than toward applied research or apparatus development.

We continue to consider it basic to accepting work under military contract that the following be met: (1) that we have skilled personnel and appropriate facilities to do a creditable job and to make a substantial contribution; (2) that the end results are primarily military; and (3) that the results will be important to the military departments or promise procurement orders for the RCA Victor Division. We are not accepting contracts to do work in fields where there are RCA reasons to undertake work and where it is proper to expend RCA funds to do the research.

The research staff increased in number by a very modest amount during the year; a similar very modest growth is planned for the coming year.

This report does not include any item on which a military-secrecy classification continues in effect. Excluding such items was decided upon in the interest of making the report of greatest usefulness.

While the material presented here is not classified in a military sense, it is highly confidential in an RCA sense; the report and the material contained in it should be so treated.

The first several sections of the report review matters of general interest in our research program. The following sections are devoted to the research projects classified by groups for convenient reference.

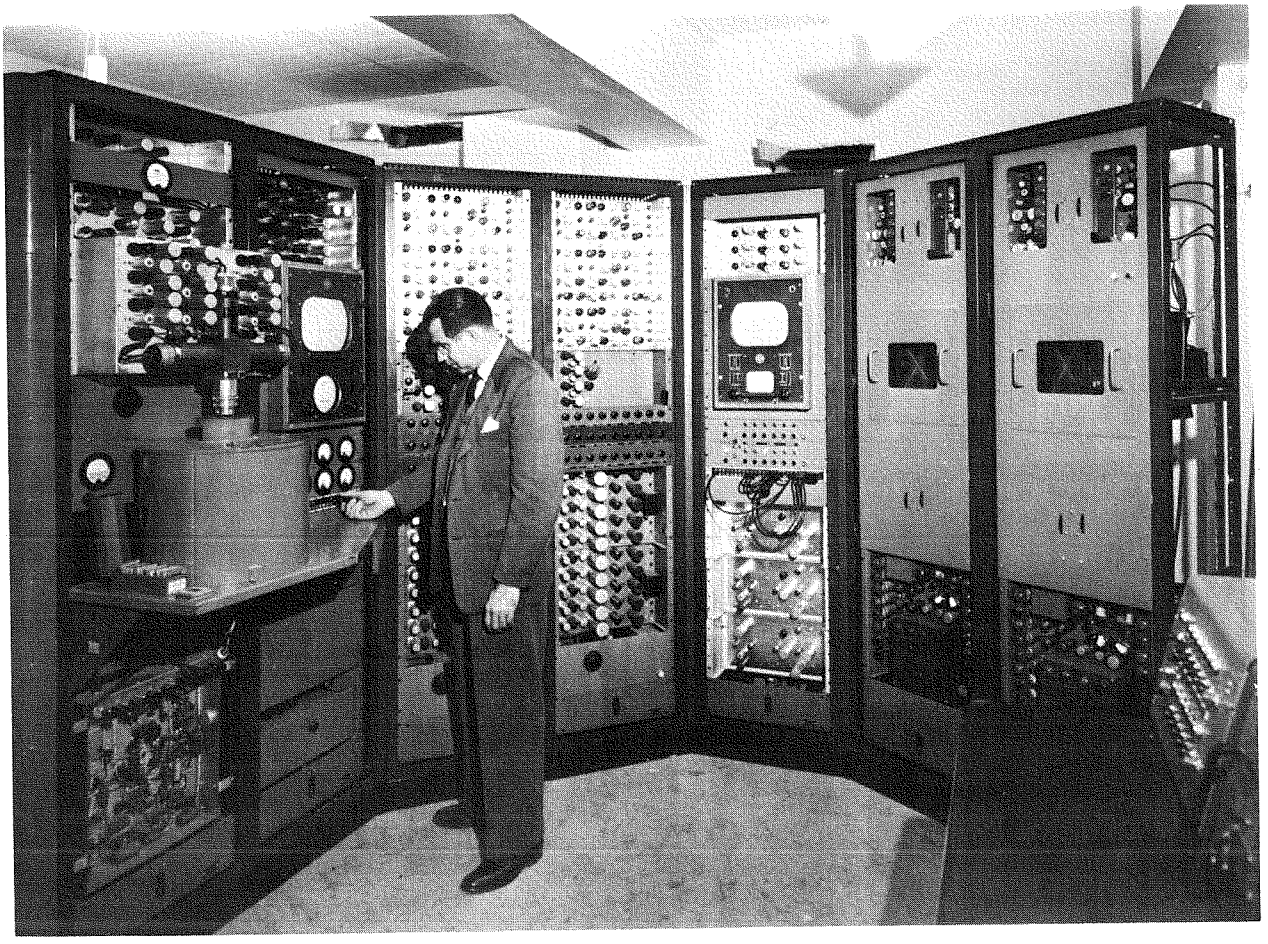
To assist the technical people of RCA who read this report, there are included at the close of each item, in the sections reviewing research projects, references to pertinent documents, technical reports and publications. Also, the names are given of

the research people to whom technical questions should be directed if further information is needed. As a general rule, where two or more names are given, the first is that of the supervisor in general charge of the research, while the others are those of men most familiar with the details of the work. The names given are not intended to be a list of those to whom credit is due for the progress reported.

While many members of the technical staff had a part in the preparation of this Research Report for 1949, special credit goes to C. M. Burrill and E. T. Dickey who compiled the material and handled the editorial work.

E. W. Engstrom

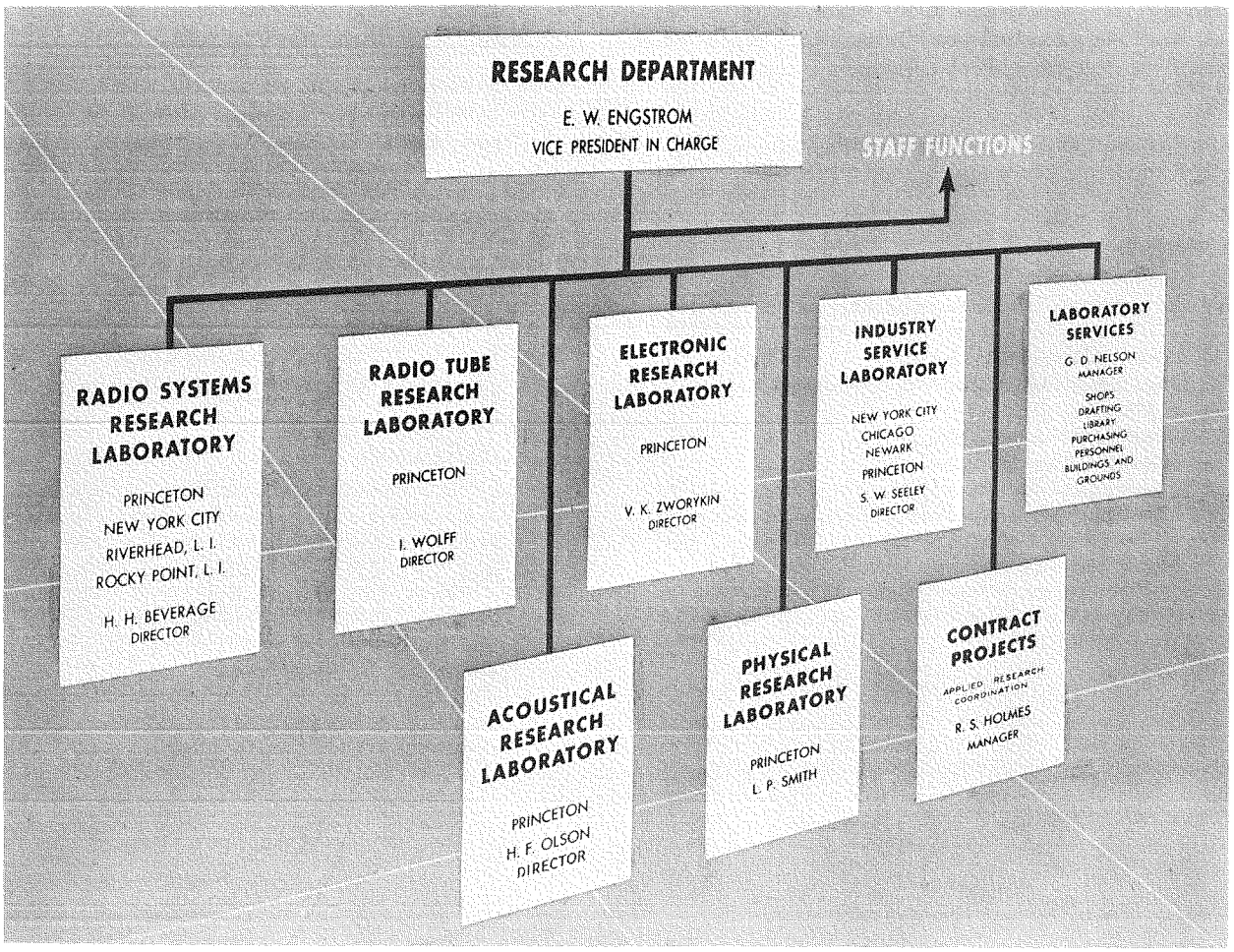
Princeton, New Jersey
February 1, 1950



Experimental color television control-room equipment installed at WNBW in Washington, D. C. for 1949 field tests and demonstrations.

Research Report
1949

CONTENTS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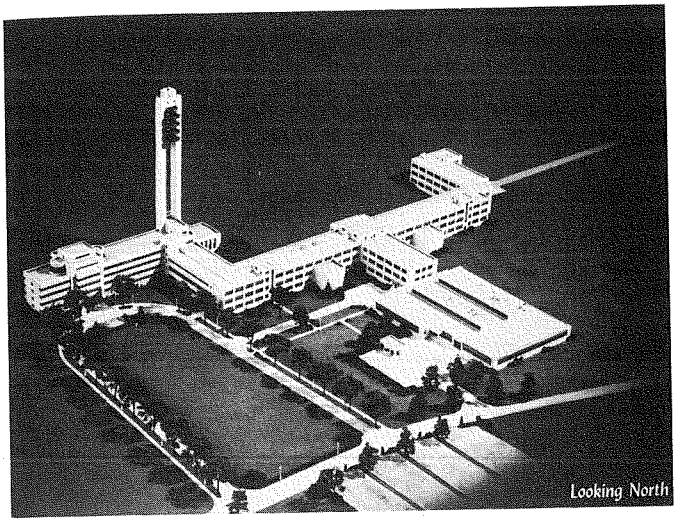
I. General Laboratory Matters

I-1 Construction Program



Experience has shown that our model making and tube making facilities are a minimum for even average work conditions. With the stress of the color television activity our facilities are adequate only through the use of an unusual amount of overtime. Further, this limitation would be emphasized if communications research groups should be moved to Princeton. Because of this we have undertaken planning looking toward expansion of our shop and tube making facilities. The planning for the extension of the shop is finished and that for tube making is in the early stages.

Aerial photograph showing building status at the close of 1949.

solved completely in a most unexpected and unspectacular fashion, namely, by giving the cut sections no treatment whatsoever. Now the sections are mounted by lifting them from the liquid surface on to a fine wire screen on which has been mounted in advance a thin collodion membrane.

For further information refer to:

J. Hillier

11-4 Electronic Memory Tube SB-256

The electronic memory tube SB-256, known in previous reports as "selectron," is an electrostatic storage tube for registering on-off signals, devised for use in high speed digital computing machines and other information handling machines. It has a capacity of 256 memory elements, any one of which is accessible without scanning or disturbing the registration of the others. The present laboratory model is three inches in diameter and seven inches long. It uses a 40-pin base which may be plugged into a special socket. The most critical of its supply voltages may vary as much as 25 percent without interfering with proper functioning. The total power dissipation is about forty watts. The tube operates entirely as an on-off device; there are no amplitude sensitive quantities involved in its operation.

With this type of selective storage tube, the writing or recording requires no previous erasure and is effected in less than 10 microseconds per element. The storage period is indefinitely long, because the electron stream replaces charge losses by leakage which would otherwise gradually dissipate the record. The reading or reproduction can be accomplished in a few microseconds notice, and may be repeated indefinitely without injury to the record. An output signal of 40 microamperes is obtained, and the input control circuits supply only reactive power.

Continuing our development of the selective storage tube during 1949, we have devised improved methods of parts fabrication and new techniques for assembly, suitable for small-quantity laboratory construction of the tubes. More than a dozen tubes have now been made and tested, and promising reliability on life test has been obtained. One

Dynamic life test equipment for SB-256 storage tubes.

pair of tubes has now operated about 1500 hours, under dynamic life test conditions similar to computer use, with no sign of a change in performance, and these tubes are still operating.

We have received several orders for SB-256 selective storage tubes from various research and development groups engaged in the computing field. The first of these orders was from International Business Machines Company. Sample tubes were sent to them and to the University of Illinois. Other orders for samples have been received from Engineering Associates, Inc., and from research groups at the University of Michigan, the University of Toronto and the Bureau of Standards. Complete information on the tube has been turned over to the RCA Victor Division at Lancaster, and they are estimating market possibilities and probable cost of early production. They have indicated that our design may be suitable for initial commercial production with comparatively little change.

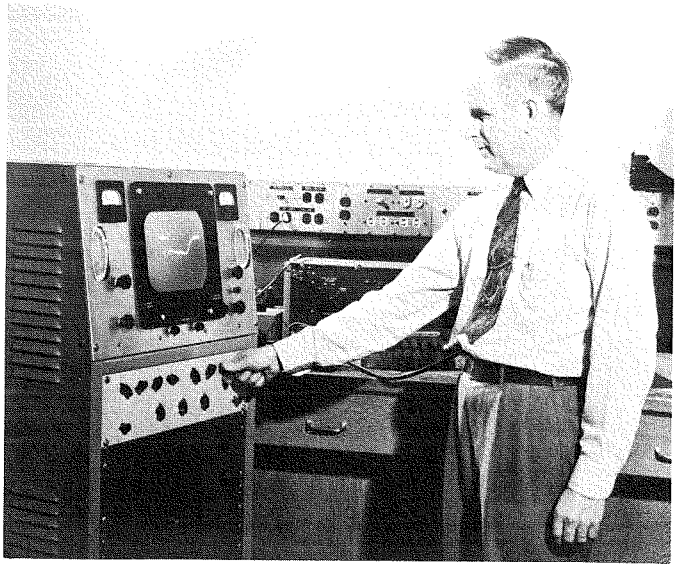
Reference: *"The Selectron - A Tube for Selective Electrostatic Storage," Jan Rajchman, RCA LABORATORIES DIVISION NEWS, August, 1949.*

For further information refer to:

J. Rajchman or M. Rosenberg

11-5 The Storage Oscilloscope

We have developed a new type of oscilloscope which enables one to observe, without the use of photography, transient phenomena which occur only once and at a rate so rapid that they cannot be observed directly on a conventional oscilloscope as they occur. It may also be used to observe recurring events when the repetition rate is too slow for the decay time of a fluorescent screen or the persistence of vision.



Research model of storage oscilloscope being used to measure the transient response of an amplifier.

In this device, which we have called a storage oscilloscope, the wave to be studied is recorded or written by an electron beam as a charge pattern on the target of a storage tube of the graphechon type. The target is then scanned in television fashion by another electron beam, and the resultant signal produces on the kinescope screen of a television monitor or receiver a visible reproduction of the stored record.

The sensitivity and speed of response of the instrument are such that events lasting only a thousand-millionth of a second may be recorded and viewed for 30 seconds or longer. This has been demonstrated by observing the pulses produced at the output of a secondary-