The Beginnings of This TRANSACTIONS

IN JULY of 1951, Ben Warriner, IEEE Microwave Theory and Techniques Society Chairman (1952–1953), circulated a petition to begin the IEEE Microwave Theory and Techniques Society under the auspices of the Institute of Radio Engineers. Despite an initial lack of support from the Institute of Radio Engineers, the roots of this TRANSACTIONS were laid and grew from that small act.

The first issue of this TRANSACTIONS was published in March of 1953. In the opening, T. S. Saad (Chairman, 1958–1959) stated, "... we are certain that the TRANSACTIONS will become one of the most important publications in the field of microwave theory and techniques." Those early words were prophetic. The size of this TRANSACTIONS has grown from 92 pages in the first year to over 3000 pages today and is recognized worldwide for its quality and truly international character.

In 1953, the cost of a membership in the IEEE MTT-S was only $2.00; memberships included copies of the TRANSACTIONS. The annual budget was set at $2144.56. Most of this TRANSACTIONS' early papers were submissions from the U.S.

Initially, each article was directly hand-typed by the author; it was not until 1955 that copies of this TRANSACTIONS were typeset. The transition to typesetting was a big step for this TRANSACTIONS and was accompanied by much fanfare. As the IEEE Microwave Theory and Techniques Society Administrative Committee had hoped, this led to a sharp increase in subscriptions.

Each early issue featured a "Distinguished Microwave Personality" and the issue included a photograph, biography, and essay written by that person. These essays treated a wide range of topics including history, mathematics, engineering challenges, and even a plea for industrial support for universities. In one early essay entitled "Wired versus Wireless," an important issue of the day, Andre Clavier quipped, "... at times we wondered whether General Ferrie, our boss, was not right when he would jokingly tell us that 'had wireless communication come first, wire would have been considered a great improvement.'" Some things never change.

This tradition was so valued that in the July 1955 "Message from the Editor," T. S. Saad apologized: "The omission from this issue of our distinguished microwave personality is regrettable. This feature has evoked much favorable comment and it is planned to continue it in all regular issues."

In honor of that tradition, and to reconnect to the origins of this TRANSACTIONS, we now reprint one of these featured essays by George C. Southworth, along with the original photograph and biography. In the essay entitled "The Challenge," Southworth expounds on the obstacles circumvented and resolved in a never-ending push to higher frequencies, exhorting his colleagues to meet the "100,000 mc" challenge, where your "new frontiers are poised temporarily." We leave it to you to determine how far we have come since 1955!

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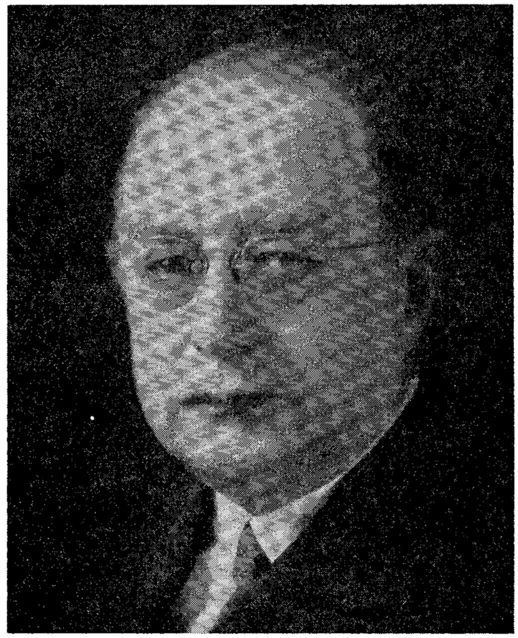
Digital Object Identifier 10.1109/TMTT.2008.916869



George Clark Southworth

Born at Little Cooley, Pennsylvania, on August 24, 1890, Dr. Southworth did undergraduate work at Grove City College and graduate work at Columbia and Yale. Then for ten years he was a teacher and for many more years a research worker on the various frequency frontiers of radio. Beginning with experimental work at Grove City College prior to World War I and continuing with research work at the Bureau of Standards and Yale University during World War I, he has been with the Bell System since 1923. He is the author of a score or more of scientific papers on such diversified subjects as ultrashort waves, the dielectric properties of water at ultrahigh frequencies, radio wave propagation, antenna arrays, earth currents, and radio astronomy, as well as that for which he is best known, waveguides. His work culminated in 1950 in a 675-page textbook on microwave techniques, "Principles and Applications of Waveguide Transmission."

For his work in waveguides, Dr. Southworth received the 1938 Morris Liebmann Prize of the Institute of Radio Engineers, and in 1947 the Stuart Ballantine Medal of the Franklin Institute. For his work on microwave radiation from the sun, he received in 1946 the Louis Levy Medal of the Franklin Institute. He is a Fellow of the Institute of Radio Engineers, the American Physical Society, and the American Association for the Advancement of Science. In his long experience in radio, he has been active in the development of several new frequency frontiers. It is natural therefore that Dr. Southworth should discuss in this issue the problems of modern microwave techniques in the light of similar problems that have been solved in the past.

The Challenge

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There are still many people who remember well when radio was used solely for telegraph purposes. At that time there was no broadcasting, no transoceanic telephony and, of course, no television or radar. Nor were there any of the countless other services now rendered by radio, such as telephone communications with airplanes and with motor vehicles. Beginning back in the early days of radio with the first appreciation that each single radio service required a separate band of frequencies, additional services meant inevitably a growth toward higher and higher frequencies. This growth passed rather swiftly with the years, first from tens of kilocycles, where commercial radio first started, to megacycles, and thence to tens, hundreds and thousands, and now more recently to tens of thousands of megacycles. With our best laboratory techniques, we are now at a rather indefinite and probably temporary frontier around a hundred thousand megacycles. This briefly is the half-century path that has led to the work of this particular Professional Group.

It is interesting that, as radio progressed, warnings were sounded at various times that troubles lay immediately ahead and each trouble, in its turn, found a solution, always with the result that radio advanced on into new and even more interesting fields. The first false alarm came in the early days of radio, when it appeared that transmission to distant points became progressively poorer with increasing frequency and that beyond about 1,000 kc the medium might indeed be useless. As most engineers know, it turned out that the region of poor transmission was confined to a relatively narrow band centering at about 1,500 kc, and beyond this frequency there was another vast region that was very useful indeed. For the want of a better name, this new region has been called the short-wave band.

As this short-wave region developed, it was soon found that at some frequency around 30 mc these very short waves no longer followed the curvature of the earth but passed into interstellar space. Thus the frequency region beyond appeared to be useful only for distances out to the horizon or slightly beyond. At first, this seemed like a distinct limitation, and again it seemed that the end of the useful radio spectrum might be at hand. However, it developed that there were numerous local services for which these higher frequencies were well adapted and again plenty of use was found. This time the new region was called the ultra short-wave band.

Prompted in part by the spirit of pioneering and in part by a need for still more services, the engineer continued to push his frontier forward. Two difficulties, long envisaged, soon became critical. In one, the coils and condensers then used as tuning elements became vanishingly small. Even more disturbing, the electron which so far had seemed so fleet-footed now appeared relatively sluggish and, accordingly, failed to perform its expected functions. With the devices in use at that time, both difficulties became particularly serious at frequencies around 1,000 mc, and for the third time it appeared that radio might have reached its limits.

In about 1931 a study was begun of the practical possibilities of transmitting very short electromagnetic waves through hollow metal pipes and along dielectric wires. Out of this work came three distinct types of elements all particularly well-adapted to the higher frequencies. These solved, for a time, the problem of vanishingly small circuit elements. Closely associated with these new developments and quite as important to the problem at hand were new techniques for dealing with electrons. Together these methods have circumvented, temporarily at least, many of the difficulties of a decade earlier and again radio has moved into greener pastures.

Prompted once more by the pioneering spirit, many of you have more recently moved still further onward. Your new frontiers are poised temporarily at about 100,000 mc. As you are finding, the circuit elements—this time resonant cavities—are again becoming distressingly small, and again the improved electronic methods are in trouble. Obviously new techniques are again needed. This is one of the challenges that confronts you as members of this group.

It is apparently not sufficient that we be plagued merely by limitations of method. We are again having troubles with the radio medium. Many years ago it became apparent that at some future time when sufficiently high frequencies were reached and the wavelength became comparable with the diameter of rain drops, substantial absorption from rain would ensue. This difficulty has long since been encountered and it has proved to be quite as real as anticipated. Absorption from rain becomes appreciable at frequencies as low as 10,000 mc and becomes serious at 30,000 mc. Presumably it becomes progressively more serious at frequencies beyond. Rain attenuation is therefore unlike the narrow absorption band type of attenuation found many years ago at 1,500 kc.

Added to these attenuations come others that are truly of the narrow-band type. One which is due to water vapor (not water droplets) occurs at a frequency of about 22,300 mc. Another, due to oxygen, occurs at 60,000 mc and perhaps also at 120,000 mc. Viewed from the infra-red end of the spectrum, we know that there must lie ahead countless other absorption bands. The outlook for purely radio applications of the frequencies that lie ahead is therefore again rather unpromising.

All of the difficulties cited above add up to one of the greatest challenges ever to confront radio research. Much of it falls to the Professional Group on Microwave Theory and Techniques, of which we are a part. We get great comfort from the thought that on previous occasions similar difficulties have been encountered and although they then seemed very real, each in its turn found a solution. Perhaps our present problem will also find a solution, but the method is not evident at the moment. In the meantime we proceed in accordance with the best traditions of our profession, calmly and one step at a time, with the assurance that even if the useful radio spectrum should terminate at its present apparent frontier, our efforts will have contributed substantially toward that much larger task of unravelling the puzzles of Nature. Being good engineers we shall, of course, try to look sharply as we go along our way for useful applications. Very likely there is a place in the waveguide type of transmission line for any new frequency regions we may open. Perhaps also there is something useful in the application of these higher frequencies to molecular physics. Then, too, there may lie ahead a new and very different kind of radio than any we have thus far envisaged. Anyway, let's accept the challenge, push on, and see what happens.