

A History of the Transactions on Microwave Theory and Techniques

THEODORE S. SAAD, HISTORY EDITOR

FROM THE EARLY days of our Society, through the many changes that have taken place in Administrative Committees, names and substance, there has been one "given." That was, and is, our TRANSACTIONS. From the first meeting of the Administrative Committee, May 1, 1952, through the name changes from Professional Group to Professional Technical Group to Group to Society¹, through twenty-eight Administrative Committees from Chairman Ben Warriner to Chairman Steve Adam, from one issue per Administrative Committee term to one issue per month, this TRANSACTIONS, above all else, has been our pride and our mainstay.

The first Administrative Committee published one TRANSACTIONS issue, that of March 1953. For that issue and the following three issues, Al Beck was appointed Chairman of the Papers Procurement Committee with Bill Mumford serving as Publications Chairman. Together they performed as Editor of the first TRANSACTIONS.

To tell the story of this TRANSACTIONS and to relate its content to the history of Microwave Technology, each of the Editors, starting with Bill Mumford, has written about his "term" as TRANSACTIONS Editor. To correlate the Editor with the TRANSACTIONS issues, a simple matrix is included as Table I.

March 1953–July 1954

W. W. Mumford, Publications Chairman

Al Beck, Chairman of the Administrative Committee

The first issues of this TRANSACTIONS were characterized by the great differences in the types of papers published. On the one hand, some papers in retrospect appear mundane, and were so even at the time, whereas others were basic, significant, and in some instances the forerunners of an entire family of papers on a new branch of technology. Since the publication was in a start-up condition, the quality of those early issues was bound to be uneven.

The March 1953 issue concentrated on circuit elements, including directional couplers, ferrites, rotary joints, compensated cavities, hybrid junctions, duplexers, and a waveguide spark gap. A new type of transmission line, MICROSTRIP, was described and a new chart for transmission line analysis, called a projective chart by the inventor, Georges Deschamps, was presented. There was one paper on attenuation measurement and one on an application of the Doppler radar technique.

The November 1953 issue contained papers on several

subjects. One paper was devoted to a description of the instrumentation of microwave electron resonance in magnetic fields, and was one of the first in this field. Sakiotis and Chait won the first Microwave Prize (1955) for their paper, "Properties of Ferrites in Waveguides." In addition, there were papers on a coaxial magic-T, circular polarizing transducers, waveguide switches, helical lines, and slots in dielectric filled circular waveguide.

The April 1954 issue was almost entirely devoted to the papers presented at the Radio Relay Systems Symposium, November 5–6, 1953, there being eleven papers devoted to the planning and development of such systems. Components (klystron design), transmission lines (microstrip), and testing (with nanosecond pulses), each had one paper in this issue.

In the July 1954 issue, there were three papers on transmission lines, three on components, one on measurement, and one on applications. The transmission line papers dealt with coaxial lines with nonconcentric dielectrics, TE_{01} components and the characteristic impedance of shielded striplines. The component papers dealt with stabilizing oscillators, use of crystals in balanced mixers, and a bibliography on directional couplers. The measurement paper was on a crystal checker for mixers and the application paper was on a travelling wave electron deflection system.

September 1954–October 1956–T. S. Saad, Editor

The September 1954 issue was a special issue devoted to a group of millimeter-wave papers that had been presented at a Joint IRE–URSI meeting held in Washington, D.C. on May 5, 1954. The papers came from two sessions organized by the MTT Society. They covered a wide range of topics, including optical measuring techniques, generation of millimeter waves by Cerenkov radiation and magnetrons, two types of millimeter waveguides, and other measurement papers. Even at that early date, there were high expectations for millimeter wave applications. That issue also marked the end of the use of offset printing for this TRANSACTIONS.

Starting with the January 1955 issue, the TRANSACTIONS was published using letter press techniques. In addition, author's photographs and biographies were included for the first time and a series of invited editorials by distinguished members of the microwave community was initiated with comments by Dr. George C. Southworth. The articles in the issue were a good reflection of the technical concerns of the time. Impedance measuring techniques, filter analysis, crystal mixer performance, and properties of a mismatched microwave network were treated.

¹For convenience, it will be referred to as Society throughout this History.

TABLE I

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total pages
1953			1								1		92
1954				2			2		3				228
1955	3		3	3			3			3		3	450
1956	3			3			3			3			274
1957	4			4			4			4			269
1958	4			4			4			4			460
1959	4			5			5			5			485
1960	5		5		5		5		5		5		676
1961	5		5		5		5		5		5		585
1962	5		5		5		5		5		5		619
1963	6		6		6		6		6		6		563
1964	6		6		6		6		6		6		625
1965	6		6		6		6		6		6		895
1966	7	7	7	7	7	7	7	7	7	7	7	7	708
1967	7	7	7	7	7	7	7	7	7	7	7	7	764
1968	7	7	7	7	7	7	7	7	7	7	7	7	1066
1969	8	8	8	8	8	8	8	8	8	8	8	8	1164
1970	8	8	8	8	8	8	8	8	8	8	8	8	1185
1971	8	8	8	8	8	8	8	8	8	8	8	8	957
1972	8	9	9	9	9	9	9	9	9	9	9	9	862
1973	9	9	9	9	9	9	9	9	9	9	9	9	857
1974	9	9	9	9	9	9	9	9	9	9	9	9*	1340
1975	9	10	10	10	10	10	10	10	10	10	10	10	1088
1976	10	10	10	10	10	10	10	10	10	10	10	10	1001
1977	10	10	10	10	10	10	10	10	10	10	10	10	1150
1978	11	11	11	11	11	11	11	11	11	11	11	11	1051
1979	11	11	11	11	11	11	11	11	11	11	11	11	1098
1980	12	12	12	12	12	12	12	12	12	12	12	12	1491

*Parts I and II

Editors of MTT TRANSACTIONS: 1—A. C. Beck and W. W. Mumford; 2—W. W. Mumford; 3—T. S. Saad; 4—K. Tomiyasu; 5—D. King; 6—R. W. Beatty; 7—S. Okwit; 8—G. Haddad; 9—F. J. Rosenbaum; 10—D. Parker; 11—J. L. Allen; 12—R. H. Knerr.

The March 1955 issue was a large issue devoted to the Symposium on Microwave Strip Circuits held at Tufts University on October 11–12, 1954, and sponsored by AFCRC and Tufts. Because of its size and the economic constraints, it was published using offset techniques. The issue was the most important one published by the MTT Society for several years. It included many basic papers on the then emerging microwave printed circuit field. The topics covered ranged from the historical background as described by Bob Barrett, to a collection of 20 papers including theory, design, and application. It was our first "special" issue. Following the March issue, and an issue of December 1955, the TRANSACTIONS fell into a pattern of quarterly publications in January, April, July, and October, which was maintained through 1959.

The three regular issues for the remainder of 1955 and the four 1956 issues were essentially alike. It was during this period that a series of articles began to appear from Stanford Research Institute dealing with stepped transmission lines, filters, strip transmission lines, etc. In fact, the two years saw a great deal of theoretical and design work on all facets of strip transmission line, providing much useful design information leading to the establishment of a number of small microwave companies. In the October 1955 TRANSACTIONS, Seymour Cohn published one of his classical papers on "Shielded Coupled-Strip Transmission Line." In the April and October 1955 issues, in a two-part paper entitled "Planar Transmission Lines," David Park treated the same subject. It is ironic that today

we search for application papers, whereas in 1955 we had a plethora of them!

In December 1955, a Special Issue was published, devoted to the MTT Group-sponsored papers presented at the 1955 URSI-IRE meeting held in Washington, D.C. The papers were a miscellaneous collection—two devoted to communications, one on X-band noise sources, others on measurements, and still others on various components. Among the components treated were the turnstile junction, the ultra-bandwidth finline coupler, and the *E*-plan forked hybrid-T junction.

The four issues published in 1956 followed the same pattern as the four regular 1955 issues. Ferrite components were beginning to receive increased attention. Interest was shown in special types of transmission lines, including the slotted coaxial line, a coaxial line with a helical dielectric support, the shielded slab line, trough line, open wire lines, and ridge waveguide. The interest in strip transmission line designs was high. A classic paper on the subject was "Coupled Strip-Line Transmission Line Filters and Directional Couplers" by Jones and Bolljohn, published in April 1956. In the July 1956 issue, Pete Strum wrote a key paper entitled "A Note on Noise Temperature," which would have its impact on microwave front-ends from then on. Len Lewin, in the October 1956 issue, wrote a paper that signaled a new era in microwave technology. It was entitled "Miniaturization of Microwave Assemblies."

It was a productive, stimulating period for microwave technology.

January 1957–January 1959—K. Tomiyasu, Editor

The 1957–1959 time period was an exciting one and the MTT Society was bustling with technical activity. The outlook was very optimistic with such developments as non-reciprocal ferrite devices, low-noise masers, and low-noise parametric amplifiers. During this period, the publication budget was expanded to publish the numerous papers, and this expansion became possible with new financial support derived from display advertising in this *TRANSACTIONS*. The successful advertising campaign is largely credited to Advertising Editor Tore Anderson's personal drive and effort.

In each issue, feature editorials were prepared by leading authorities in the microwave profession, and these editorials provided keen insight and guidance on various aspects dealing with the profession. Many of these authors have been subsequently recognized by IEEE and MTT awards. Starting with the July 1958 issue, a list of the Editorial Board members was published on the masthead to provide visibility to those individuals who gave freely of their time to voluntarily support the profession.

Annual reports of microwave advances were published in July 1958 and July 1959. In the July 1958 issue, the 13-page report prepared by R. E. Beam listed papers published in journals printed in the United States and overseas. One year later, the arduous task was distributed among four authors covering the journals published in Great Britain, Western Europe, Japan, and the United States, respectively. This four-part report required 25 pages in the issue.

Early work on low-noise masers used gases with very limited bandwidth, such as ammonia. A paper worth noting is the one describing the three-level solid-state maser by H.E.D. Scovil which appeared in the January 1958 issue. The noise temperature was below 35 K, the gain was 20 dB at 6 GHz, and the crystal used was lanthanum ethylsulfate containing $\frac{1}{2}$ percent gadolinium and $\frac{1}{5}$ percent cerium. One year later, in January 1959, a solid-state maser operating at an unprecedented low frequency range of 300–500 MHz was reported by R. H. Kingston. A noise temperature of 70 K was obtained using chromium-doped potassium cobaltcyanide.

The keen interest in ferrite characteristics and the high utility of ferrite devices were evidenced by 46 papers published during this period. The frequency range was increased, higher power levels could be handled, and greater isolation and lower losses were achieved.

The measurement of harmonic-frequency power propagating in a waveguide is made difficult by the multiplicity of modes at such frequencies. A rapid multiprobe technique to measure harmonic power in *L*-Band and *S*-Band waveguide was reported by V. G. Price in the January 1959 issue.

The design of high performance filters is laborious when performed by hand. The use of a digital computer not only reduces the manual effort involved but performs the calculations more accurately in less time, and permits iterative design changes with great ease. Such benefits were reported

in a paper by L. Young published in the January 1959 issue.

The parametric amplifier, known as the paramp, evolved during 1958 and 1959. The advantages are low-noise amplification, relatively wide bandwidths, and room temperature operation. A classic paper by K. Kurokawa and J. Hamasaki appeared in the July 1959 issue reporting on a periodically distributed paramp.

April 1959–November 1962—D. D. King, Editor

This interval in MTT publication history falls near the peak of ferrite devices development. Beginning with the Microwave Prize Paper by Auld on the synthesis of symmetrical waveguide circulators (April 1959, pp. 238–246), we find contributions which provide a deeper understanding of the operation of devices first reported several years earlier. The paper by Schlomann on the theory of ferrite resonance isolators (March 1960, pp. 199–206) falls in this category as well. An important new class of ferrite devices, tunable single crystal YIG filters, is first described by Carter (May 1961, pp. 252–260). The extension to elliptical polarization, leading to nonreciprocal tunable bandpass filters, appears in a subsequent paper by Patel (May 1962, pp. 152–161).

Parametric amplifiers had also reached a stage of maturity of design. Here again the pace is set by a Microwave Prize Paper by Matthaei on the optimum design of wide-band parametric amplifiers and upconverters (January 1961, pp. 23–28). The theory was verified in a subsequent paper on the practical design of wide-band degenerate parametric amplifiers by Gilde and Matthaei (November 1961, pp. 484–490). The related topic of TEM diode switching was subjected to a definitive analysis by Garver (May 1961, pp. 224–238).

Filters are a subject that remained on a high plateau of publications for many years. A classical contribution to the design of microwave filters on the insertion loss basis was made by Matthaei (November 1960, pp. 580–591). The structures available to microwave designers offer opportunities for specialized filter types, so the ubiquitous Matthaei successfully adapted the interdigital structure to bandpass filters (November 1962, pp. 479–491). A systematic analysis of quarter-wave transformers as impedance matching and filter prototype elements was provided by Young, another prolific MTT author (September 1962, pp. 339–359).

The accelerating pace of microwave activity created a growing need to shorten the time interval between receipt of manuscripts and publication. In response, preparations were made to shift to a bimonthly schedule. This was accomplished, and the last quarterly issue of the MTT *TRANSACTIONS* appeared in October 1959.

With the benefit of hindsight, we can distinguish a number of articles which introduce a subject on which more would be written in subsequent years. A significant precursor of this sort is the article on gallium arsenide point-contact diodes by Sharpless (January 1961, pp. 6–10).

The author correctly predicts that parametric amplifiers using such diodes may become competitors for masers in low-noise amplification. In the paper on microwave reflectometer techniques by Engen and Beatty (July 1959, pp. 351–355), the rigorous analysis of errors and the simplification of procedure improved the performance of much future microwave measuring equipment. Further refinement of the analysis of microwave measurements was made by Hunton (March 1960, pp. 206–212), who successfully applied the method of signal flow graphs.

Progress was relatively continuous following the examples just cited. A case in which considerable time elapsed before wide application occurred is the work on complementarity in transmission lines by Owyang and King (March 1960, pp. 172–180). The slot dual of open-wire lines treated by the authors was followed nine years later by the single-slot dual of a stripline.

January 1963–November 1965—R. W. Beatty, Editor

During 1963–65, a number of developments reported in the MTT TRANSACTIONS reflected progress in microwave technology. There was great interest in extending microwave technology to millimeter-wave frequencies, as reported in the September 1963 issue of the MTT TRANSACTIONS on the Orlando, FL Conference. Additional progress in millimeter-wave technology was again reported in 1965 at the Boulder Millimeter and Far Infrared Conference held in Estes Park, CO.

The research on beam waveguides at millimeter, sub-millimeter, and optical frequencies revealed many practical problems, including maintenance of alignment of the beams. Later, the glass fiber proved to be a better optical waveguide, and helical waveguides were developed for millimeter wave transmission.

Activity was high in microwave solid-state technology during this period. Gunn-type and avalanche diode oscillators were introduced, but could not yet compete with transistor driven varactor multiplier chains (Sterzer, November 1965). Much progress was made in the development of ferrite devices such as circulators and phase shifters, using stripline to produce compact, broad-band devices (Bosma, January 1964). Other solid-state microwave advances occurred in the development of YIG devices, such as filters, delay lines, and limiters. The ruby laser, developed in 1960, was used in 1963 to pump a ruby maser operating at 22.4 GHz. It was hoped that a similar laser-pumped maser could be made to operate at 300 GHz. The computer was being used in microwave design—for example, in 1963, to calculate coaxial step capacitances, in 1964, in microwave filter design, and in 1965, to calculate characteristic impedance and attenuation of striplines.

Strong activity in microwave filter design resulted in a special issue on this subject in September 1965. It was noted that completely new types of circuit elements were coming into use, such as YIG-sphere resonators and high dielectric-constant disks. Microwave standards at the national level were being developed rapidly—especially in

power, impedance, and attenuation. The first international comparison of microwave standards was reported in 1965; it was a comparison of microwave power standards which took place at 10 GHz and involved Japan, the United States, and the United Kingdom.

The expansion in microwave developments which had caused this TRANSACTIONS to go from quarterly to bimonthly publication after 1959 continued. Concern over long delays in publication of TRANSACTIONS papers reached a head around 1964, and a committee was formed at a TRANSACTIONS Editors' meeting in New York to investigate causes of the delays. The MTT TRANSACTIONS Editor headed this committee and worked with E. K. Gannett and Ms. Helene Frischauer at IEEE Headquarters. All editorial processes occurring between receipt of a paper by the Editor and receipt of the published article by a TRANSACTIONS subscriber were reviewed. Although the committee report recommended no basic process changes, a better appreciation was gained of the times required for various steps in the publication and review process. Subsequently, the MTT TRANSACTIONS Editor pushed for monthly, rather than bimonthly, publication in order to shorten publication time. With the January 1966 issue, the TRANSACTIONS became a monthly.

In 1965, this TRANSACTIONS was averaging 150 pages per issue, and the load on the Editor was becoming heavy. The question of paid versus volunteer editorship was considered. It was considered desirable to retain volunteer editorship, and this was a factor weighing against a proposal to merge several TRANSACTIONS. Although such a merger never occurred, MTT editors eventually received financial support from IEEE in the next decade.

Controversial incidents in the history of this TRANSACTIONS tend to go unreported, and perhaps rightly. Some of the confrontations that almost reached the Correspondence Section of the TRANSACTIONS will never be reported in writing, since living persons might be offended, and no useful purpose would be served. However, a few incidents are reported here for their interest and to clear the record. The organizers of the excellent Millimeter and Submillimeter Wave Conference held in Orlando, FL, in January 1963 deserved more recognition than they received in the brief note on p. 269 of the September 1963 issue. However, they had gone ahead without prior approval and support of the MTT Administrative Committee, and some of the Committee members felt that this procedural error should not go unpunished. The TRANSACTIONS Editor was caught in the middle, and bent, but did not break, under the pressure.

Another awkward situation occurred after D. D. King had given an inspired keynote address at the 1965 MTT Symposium. The Microwave Journal was enthused about this address, and wished to publish it. However, Don King, a former TRANSACTIONS Editor, decided to submit it to this TRANSACTIONS, where it was published under his name, but without listing his affiliation or noting that it was a keynote address. Fortunately, this was all clarified in the writeup covering the Symposium.

A final embarrassing incident was the appearance of a blank cover page on the first monthly issue of this TRANSACTIONS, in January 1966. The responsibility for this blooper has never been determined, and will probably remain a mystery in the history of this TRANSACTIONS.

January 1966–December 1968—S. Okwit, Editor

Progress on all technology fronts continued during this period. Millimeter waves, optical transmission lines, filters, and solid-state were only a few of the areas treated. Not only were special issues devoted to the Annual Symposia of 1966, 1967, and 1968, but the July 1968 issue was a Special Issue on Microwave Integrated Circuits and the September 1968 issue was a Special Issue on Noise. The publication of special issues devoted to these two subjects was a direct reflection of their importance and high interest.

This TRANSACTIONS continued to carry articles and correspondence that laid a solid foundation of theoretical and practical knowledge. A good example is the paper by J. Paul Shelton, Jr., on "Impedances of Offset Parallel-Coupled Strip Transmission Lines" (January 1966), which has been cited and used many times by workers in the field. In the same issue, the growing concern for precision coaxial standards was evidenced in a paper by MacKenzie and Sanders on "Some Fundamental Design Principles for the Development of Precision Coaxial Standards and Components."

Other papers on stripline and microwave integrated circuits covered such diverse topics as slit-coupled strip transmission lines, the consideration of lumped elements in microwave integrated circuits, losses in microstrip, the coupling of pairs of microstrip lines, and the analysis of microstrip lines.

The concern for phase and its measurement was also clearly growing during this period, with several papers covering the subject. Waveguide appeared to be one of the more popular topics, from both the theoretical and practical aspects. There appeared to be interest in various dielectrics and semiconductors when used inside waveguides. Tunnel diodes, varactor diodes, and IMPATTs were treated and the application of various types of diodes at millimeter waves was given some consideration. The treatment of the diode as a microwave circuit was covered in more than one paper.

Millimeter wave papers were appearing with increasing frequency; they appeared to be focusing on actual applications of devices, for example switches, multipliers, circulators, etc. Papers on ferrites not only covered the theory, design, and application of circulators but responded to the growing interest in ferrite phase shifters as well.

With increasing utilization of the microwave frequency spectrum, the need for more and better filters continued to grow, resulting in a large number of excellent papers on the subject. The treatment of elliptic-function filters appeared in several papers throughout the period. One paper by Schiffman and Young gave design tables for an

elliptic function bandstop filter (October 1966). Another paper by Levy and Whitely described the "Synthesis of Distributed Elliptic Function Filters from Lumped Constant Prototypes" (November 1966); the consideration of all pass networks was treated in a two-part paper by Scanlon and Rhodes (February 1968).

One of the trends that seemed to become more apparent during this period was the increased number of theoretical papers in the main body of this TRANSACTIONS, as contrasted with the number of application-type short papers that appeared in the correspondence section. It is also interesting to note how many of the correspondence items were focused on practical and useful applications of microwave products.

During this period, two Microwave Prize Papers were published, one by R. J. Wenzel entitled "Theoretical and Practical Applications of Capacitance Matrix Transformations to TEM Network Design," which appeared in the December 1966 issue, and one by W. F. Gabriel on "Tunnel Diode Low Level Detection," which appeared in the October 1967 issue. The period, perhaps, could be best characterized as one in which the various component parts needed for the gradual changeover to microwave circuit technology began to reach its peak.

January 1969–January 1972—G. I. Haddad, Editor

During this period a great deal of emphasis was placed on expanding the interest of the microwave theory and techniques community in a number of different areas. But even before the period started, in the issue of January 1969, voluntary page charges were introduced. The problem of voluntary page charges has been studied over the intervening years. Many different methods have been attempted in order to increase the income from that source. Despite the introduction of the page charges, the technical aspects of this TRANSACTIONS continued to blossom and grow.

One of the most active areas was that of active microwave solid-state devices and circuits and the utilization of these solid-state devices in amplifiers and oscillators. Two special issues on the subject were published during this period. The first was in November 1970, on microwave circuit aspects of avalanche diodes and transferred electron devices; the second was another special issue on microwave integrated circuits and was published in July 1971. Further reflecting the interest in solid-state devices was the fact that two of the Microwave Prizes presented during this period were devoted to this area of the technology. The first was the 1970 prize, which was awarded to William J. Evans for his paper entitled "Circuits for High Efficiency Avalanche Diode Transistors," which appeared in December 1969. The second was awarded to Marion E. Hines in 1971 for his paper entitled "Reciprocal and Non-Reciprocal Modes of Propagation in Ferrite, Stripline and Microstrip Devices," which was published in May 1971.

A second area on which great emphasis was placed was that of microwave acoustics and applications. Again, in an

effort to stimulate interest and to properly treat the subject, a Special Issue on Microwave Acoustics was published in November 1969.

Over the preceding years, more and more papers were appearing that contained computer-generated tables of design parameters; however, as more and more microwave engineers had computer capability available to them, the interest in computer-oriented microwave practices and automated microwave measurements began to receive greater attention. As a consequence, a Special Issue on Computer-Oriented Microwave Practices was published in August 1969. In that issue, a new section was included entitled Computer Program Descriptions. That section is a regular part of this TRANSACTIONS since that time. A second special issue on the subject of automated microwave measurements, which was jointly sponsored with the Instrumentation and Measurements Group of IEEE, was published in January 1972.

A fourth area of expanding interest was the question of biological effects of microwaves. This had a two-fold impact on the MTT Society. The first was the subject itself—which was unrelated to design and end products—and the second was the fact that it forced the MTT Society to face the problems of dealing with a public issue. A Special Issue on Biological Effects of Microwaves was published in February 1971.

In addition to all of these special issues and special areas of interest, the annual Symposium issues appeared in December of each year. Other subjects such as filters, ferrites, waveguide designs, theory, etc., were still receiving serious attention. Filters in particular were being treated with many significant papers. John David Rhodes, in particular, published a number of papers on various subjects relating to filter design. He received the Microwave Prize for 1969 for two papers that appeared in the April 1969 issue, the first entitled "The Stepped Digital Elliptic Filter" and the second entitled "The Design and Synthesis of a Class of Microwave Bandpass Linear Phase Filters."

All of the areas described above are still very active, and they represent significant areas of interest to microwave theory and techniques engineers.

February 1972–January 1975—F. J. Rosenbaum, Editor

The years 1972–1974 marked a transition in the nature of the TRANSACTIONS in several ways. The continued effects of the recession in engineering at that time were felt in the MTT Society by a decrease in membership, budget limitations, and, subsequently, a significant reduction in the number of pages allotted for publication. This had the effect of increasing the publication time delay and forcing difficult editorial decision. One response was to place limits on the length of manuscripts being considered. A Short Papers section was created to encourage the submission of brief articles, and a balance struck to publish more short papers per issue than full length papers.

During this period, evidence of the shift from U.S. dom-

inance in microwaves became apparent as the number and quality of overseas contributed manuscripts grew. In many TRANSACTIONS issues, non-U.S. papers were in the majority. The growth in the number of papers from overseas universities was accompanied by a reduction in the submission of papers from U.S. industries and universities. This is indicative of the increased competition felt by many companies and of federal research funding cutbacks experienced by U.S. industry and universities. Our current shortage in trained microwave people and the lag in certain areas of technology were presaged in the contents of TRANSACTIONS during this time.

A continuing effort was made to broaden and deepen MTT Society involvement in developing technologies by means of the special issues. From 1972–1974, six were published:

April 1973—Microwave Acoustic Signal Processing (T. M. Reeder);

November 1973—Solid State Microwave Power Amplifiers (M. E. Hines);

March 1974—Computer Oriented Microwave Practices (J. W. Bandler);

June 1974—Microwave Control Devices for Array Antenna Systems (L. R. Whicker);

December 1974—Proceedings of the First International Conference on Submillimeter Waves and their Applications (K. J. Button);

January 1975—Integrated Optics and Optical Waveguides (D. Marcuse).

The special issues have tended to become landmarks in their respective areas.

Steady progress in the applications of electromagnetic theory to optical and microwave waveguides, in component development, in MIC models, and a multitude of other topics of interest to the microwave community was reported during these years. Highlighting each year is the Microwave Prize for the most outstanding paper to appear in the MTT TRANSACTIONS. Prizes were awarded to: D. T. Young and H. E. Rowe, "Optimum Coupling for Random Guides with Frequency-Dependent Coupling," June 1972; W. R. Smith, H. M. Gerard, and W. R. Jones, "Analysis and Design of Dispersive Interdigital Surface-Wave Transducers," July 1972; and C. A. Liechti and R. L. Tillman, "Design and Performance of Microwave Amplifiers with GaAs Schottky-Gate Field-Effect Transistors," May 1974.

While 1972–1974 was a difficult time for the MTT Society, this TRANSACTIONS was able to maintain its reputation for excellence.

February 1975–December 1977—D. Parker, Editor

For several years there had been a strong interest on the part of the Administrative Committee and some of the members to attract and publish more application papers. Rather than create a second journal, it was felt that high-

lighting the application papers in some fashion would communicate the message that application-oriented papers were recognized by the MTT Society to be as important and valuable as theoretical papers.

Consequently, in 1975, a policy was instituted of grouping papers together and publishing, in alternate months, issues with "Accent on Theory" or "Accent on Application." Over the period 1975–1977, application papers represented about 40 percent of those published. Special Issues set the pace for new technological areas of interest to the microwave theory and techniques community. The January 1975 issue was a Special Issue on Integrated Optics and Optical Waveguides (initiated while Fred Rosenbaum was editor). Throughout the period 1975–1977, several papers were published on optical waveguides and on dielectric waveguides for millimeter-wave propagation. The optical waveguide technical community grew rapidly, and a new society with a journal of its own was organized in 1977.

The early seventies saw a resurgence of interest in the biological effects of microwave radiation. From 1975 through 1977 over 14 papers were published in this TRANSACTIONS on the electromagnetic fields inside various theoretical models of man, power absorption, and various dosimetry techniques. This field is multidisciplinary in nature, and attracts professionals with a wide variety of backgrounds. As a consequence, other forums in addition to the MTT Society, which is highly engineering-oriented, were sought to promote interchange of ideas and research. However, the MTT Society continues to solicit and publish papers in this field. A Special Issue on Microwaves in Medicine was initiated in early 1977 and published in August 1978.

In March 1975, this TRANSACTIONS published a letter from K. Araki *et al.* of Japan on a new type of isolator that had high isolation over a broad band and was based on the edge-guided mode. This letter sparked additional interest in edge-guided mode devices, and several papers on isolators and circulators were subsequently published.

Practical applications for millimeter waves appeared to be taking hold, finally. A Special Issue on Millimeter Wave Circuits, Components, and Systems was published in November 1976. Also, the need for compact circuits and the ability to maintain tight tolerances at potentially low cost in production has prompted some interesting research on printed-circuit techniques at frequencies from 18 to 100 GHz. Of particular interest are mixer designs for both broad-band ECM and narrow-band communications or radar applications. Harmonically pumped mixers (hyperbolic sine mixers) have generated interest at millimeter-wave frequencies because of the unavailability of low-noise Gunn-diode oscillators above 60–70 GHz.

Planar circuits where the circuit element size is comparable or greater than a wavelength in two dimensions and much less than a wavelength in the third dimension are also receiving more attention for printed circuit appli-

cations. The three-part microstrip circulator is one example, but other applications, such as resonators for oscillators, are also of interest.

Ken Button has been instrumental the past few years in organizing international conferences on submillimeter waves and their applications. The June 1977 issue of the MTT TRANSACTIONS was a Special Issue on Submillimeter Waves, with Ken Button as the Guest Editor. He published a selection of the papers presented at the December 1976 Submillimeter Wave Conference. The June 1980 issue is a Special Issue for the papers from the December 1979 Conference. It is planned to hold this Conference annually henceforth, and to reserve space in this TRANSACTIONS for important papers from these conferences.

The long lead times necessary to solicit papers, have them reviewed, and then process them through publication, means that Special Issues must be planned eighteen months or more in advance. It may be worthwhile to mention some special issues that were initiated during this period: Microwave in Medicine, August 1978 (Bill Guy, Guest Editor); Microwave and Millimeter Wave Integrated Circuits, October 1978 (Reinhard Knerr, Guest Editor); 27 Year Index, October 1980 (George Oltman, Guest Editor); Solid State Microwave and Millimeter Wave Power Generation and Modulation, May 1979 (John Kuno and Bert Berson, Guest Editors). George Oltman, Associate Editor for Applications, has assisted in getting these special issues initiated, and tracking their progress with the Guest Editors.

Charles Liechti was Guest Editor on another special issue of importance to the readers of the MTT TRANSACTIONS, namely, the Special Issue on Microwave Field Effect Transistors (June 1976). The application of these devices to low-noise receiver front ends and moderate power sources is well recognized. Another application for FETs that will require the knowledge and techniques used by microwave engineers is high-speed logic and modulators. Liechti has published on this subject in this TRANSACTIONS, and it is anticipated that the MTT TRANSACTIONS will provide a home in the future for many papers on the design of these circuits.

Aside from the developments in the technical content of this TRANSACTIONS, policy changes were made during the period. The Short Paper category was discontinued in early 1977, and effectively all papers were published as full papers. This change was made in hopes that all manuscripts would be judged equally on the basis of their technical accuracy and usefulness, and their lengths would be consistent with the need to include only relevant design information, data, and descriptions.²

The paper category of Technical Notes was then introduced in response to the need to quickly publish new infor-

²Further, it had been the policy to credit only the authors of full-length papers with inclusion of their biographies and pictures in the issues. Authors of Short Papers were not so honored. In the opinion of some members of the Administrative Committee, this was the most valid reason for discontinuing the Short Paper category.—*Guest Ed.*

mation of engineering significance and usefulness, without waiting for the full and complete development of a design as is characteristically reported in a full paper in this TRANSACTIONS. By limiting these Notes to one or two pages of author-prepared photo-ready copy, we are able to reduce their publication time.

Also during this period, mandatory page charges were instituted for papers whose length exceeded five published pages. In addition, a quota system was instituted that could limit the number of pages published each month that were not covered by page charges. These last two actions were taken to keep this TRANSACTIONS on a sound financial basis in the face of rapidly increasing publication costs.

The positions of Business Editor and Associate Editor for Applications were instituted near the beginning of my term as Editor. Jim Degenford and George Oltman were the first Associate Editors filling these positions.

January 1978–December 1979—J. L. Allen, Editor

This period was one of relatively few problems other than those associated with the expected but frustrating long lead times necessary to get papers properly reviewed and processed through publication. The thrust towards increasing the number and quality of application-oriented papers was continued. The position on page charges was consolidated and proven to work smoothly. The page charge system consists of voluntary charges for papers less than five published pages in length and mandatory charges for papers exceeding five pages, coupled with a quota system limiting

the number of pages published each month that are not covered by charges.

To aid future incoming editors and their staff, a very complete "how-to-do-it" operations and procedures manual was developed and published, primarily through the efforts of the Editor's assistant, Lynn Federspiel.

Technical interest during this interval keyed on increasing activity in millimeter-wave circuits and power sources (special issues October 1978, May 1979), GaFET devices and circuits, high power components (special issue May 1978), and microwave applications in cancer treatment (special issue August 1978). The 1979 Microwave Prize was awarded for the paper "Conversion Loss and Noise of Microwave and Millimeter-Wave Mixers: Part I—Theory, Part II—Experiment," by Anthony R. Kerr and Daniel N. Held, published in the TRANSACTIONS, Vol. MTT-26, February 1978. The 1980 Microwave Prize was awarded for the paper "Subharmonically Pumped Millimeter-Wave Mixers," by E. R. Carlson, T. F. McMaster, and M. V. Schneider, published in the TRANSACTIONS, Vol. MTT-26, October 1978.

The combined efforts of Lynn Federspiel, the Associate Editors (H. G. Oltman, Jr., J. E. Degenford, B. Perlman, M. Caulton, T. Okoshi, and H. E. Schrank), and a host of dedicated reviewers produced a smoothly running operation and continued the tradition of a TRANSACTIONS built around technical material of high quality.

January 1980 to date—R. H. Knerr, Editor

Term incomplete.