Dr. Rudolf Bechmann was born in Nuremberg, Germany. He received his Ph.D. in Theoretical Physics in 1927 from the University of Munich under Arnold Sommerfeld. His scientific career began thereafter with the Telefunken Company in Berlin where he investigated antennas and antenna systems. In 1932, he discovered the EMF method for calculating antenna characteristics. He then began work on piezoelectric crystals and in 1933 was one of the independent inventors of the AT-, BT-, CT-, and DT-cuts of quartz, continuing his work with Telefunken until 1945. From 1945 to 1948 he directed research at Oberspree Company; in 1948 he became principal scientific officer at the Post Office Research Station, Dollis Hill, London, where his work on water-soluble, highly piezoelectric crystals led to the publication of the book "Piezoelectricity" (Her Majesty's Stationery Office, 1957).

In 1953 Dr. Bechmann came to the United States to work at the Clevite Research Center, Cleveland, Ohio. Here he was active in the investigation of man-made quartz. He remained with Clevite until 1956 when moved to work in what is now the Electronics Technology & Devices Laboratory, US Army Electronics Command, Fort Monmouth, NJ. Dr. Bechmann was then

Dr. Walter Guyton Cady was born in Providence, R.I. He received a bachelor's degree from Brown University in 1895 and a master's in 1896. After teaching there for two years, he went to the University of Berlin, where he received his Ph.D. in Physics in 1900. Dr. Cady spent two years with the Coast and Geodetic Survey and joined the faculty of Wesleyan University, Middletown, Connecticut in 1902. He served as Associate Professor from 1902 to 1907, and as Professor from 1907 to 1946. During this time he did pioneering work in the area of piezoelectricity, and development of practical devices using the piezoelectric effect. He was one of the earliest workers in frequency selection and control and devised the first crystal-stabilized circuit, as well as one of the earliest crystal-controlled oscillators. Prof. Cady won the Morris Liebmann Memorial Prize of the IRE in 1928 and was its president in 1932. He was the second American to receive the Duddell Medal of the Physical Society of London. The award, in 1937, was for the quartz crystal clock, measurement and control of frequency and ultrasonic velocity measurements. Dr. Cady received honorary degrees from Brown University in 1938 and from Wesleyan in 1958.
chiefly concerned with developing resonators for filter applications, and with temperature-coefficients of doubly-rotated plates. During this time he was also contributing author to "Landolt-Bornstein," writing comprehensive sections relating to elastic, piezoelectric, dielectric, piezooptic, electrooptic and nonlinear elastic constants of piezoelectric crystals. Dr. Bechmann retired from Fort Monmouth in 1971 having written approximately 100 technical papers and having been issued 53 patents in Germany, England and the United States. He received the C. B. Sawyer Memorial Award in 1966, and was a fellow of the American Physical Society, the American Association for the Advancement of Science, the New York Academy of Science and of the Institute of Electrical and Electronics Engineers. In 1972 he was awarded the honorary degree of doctor of natural science by the University of Cologne, Germany.

As his publications have not been listed in print before, they are given below.

Published Works of R. Bechmann

A. Periodicals

1) A.A. Michelson's method for the determination of the magnitude of the fixed stars as applied to ultramicrons. Ann. d. Phys. (IV) 84, 1927, 61-93 (Dissertation, München)


4) Calculation of the radiation diagram of antenna combinations. Telefunken-Ztg. 10, 1929, No. 53, 54-60 (December)


8) Computation of radiation resistance of antennas and antenna systems. Telefunken-Ztg. 11, 1930, No. 55, 52-63 (October)


10) On the radiation field of a cy Z. f. F ______ , 1931, 30-32

11) The spatial radiation diagrams of the Telefunken Elektro ______ .

12) On the dipole antenna. Telefunken ______ . 57, 43-46 (April)

13) On the radiation power of a dipol Telefunken ______ . 61, 51-54 (July)

14) On new quartz oscillators. E.N.T. ______

15) The development of a quartz control for the Telefunken mitter. Telefunken ______ . 63, 17-29 (April)

16) Piezoelectric quartz crystal oscillators with arbitrary temperature coefficient particularly with the value zero. Naturwiss. 21, 1933, 752 (Original brief notice). No. 42 (20. Oct)

17) The crystal control of transmitters: Telefunken high-power broadcasting arrangements. Wireless Eng. and Exp. Wireless 11, 1934, 249-253 (May)


After retiring from Wesleyan in 1946 he became Emeritus Professor and Research Associate at the California Institute of Technology, where he continued his experiments. Also in 1946 his monumental book "Piezelectricity" was published by McGraw-Hill; it has since been revised and a second edition was published by Dover in two volumes in 1964. It is the standard work in the field. Dr. Cady was still carrying on an active correspondence with colleagues when he passed away on the eve of his one hundredth birthday. A centennial lecture in his honor was delivered on 5 December by Dr. Warren P. Mason of the Bell Telephone Laboratories; this lecture appears in J. Acoust. Soc. Am., Vol. 57, April 1975, and may be consulted for further details of Dr. Cady's full and fruitful life. Professor Cady was a Fellow of the Physical Society (London), of the Institute of Electrical and Electronics Engineers, of the American Academy and of the Acoustical Society of America.
19) The measurement of the sound velocity in anisotropic media, especially in quartz, by piezoelectric excitation. 

20) Development of the quartz control of the large Telefunken transmitter. 2nd part. 
Telefunken-Ztg. 15, 1934, No. 68, 16-24 (October)

21) Investigations of the elastic resonance frequencies of piezoelectrically excited quartz plates. 
z. f. techn. Phys. 16, 1935, 525-528 (December)

22) Quartz oscillators. 
Telefunken-Ztg. 36, No. 72, 36-45 (March)

23) Quartz resonators. 
Telefunken-Ztg. 337, No. 76, 5-15 (July)

24) On circuits for electric quartz oscillators and resonators in frequency stabilization and selection. 
Telefunken-Ztg. 338, No. 78, 60-69 (March)

25) Thickness vibrations of piezoelectrically excited crystal plates. 
Hochfrequenztechn. u. Elektroak. 56, 1940, 14-21

26) Elastic vibrations of an anisotropic body in the form of a rectangular parallelepiped. 
z. f. Phys. 117, 1941, 180-197.

27) Longitudinal vibrations of square quartz plates. 
z. f. Phys. 118, 1942, 515-538 (February)

28) Properties of quartz oscillators and resonators in the frequency range from 300 to 5000KHz. 
Hochfrequenztechn. u. Elektroak. 59, 1942, 97-105 (April)

29) Quartz control. 
Funk, 1942, No.19/20, 257-261.

30) Longitudinal vibrations of rectangular quartz plates. 
z. f. Phys. 120, 1942, 107-120

31) Quartz oscillators and resonators in the range from 50 to 300 KHz. 
Hochfrequenztechn. u. Elektroak. 61, 1943, 1-12 (January)

32) Elastic resonance vibrations of a rectangular quartz parallelepiped. 
z. f. Phys. 122, 1944, 510-526

33) Axial longitudinal vibrations of a straight bar of crystal material. Together with V. Petříček. 
z. f. Phys. 122, 1944, 589-599.


Nature (London) 163, 1949, 915-916, No. 4154 (11 June)

36) Piezoelectric resonator of ethylene diamine tartrate with zero temperature coefficient of frequency. 
Nature (London) 164, 1949, 190-191, No. 4161 (30 July)

37) Determination of the elastic and piezoelectric coefficients of monoclinic crystals, with particular reference to ethylene diamine tartrate. 


39) Temperature dependency of quartz resonators. 
Archiv d. elektr. Übertragung 5, 1951, 89-90


41) On the practical execution of the transformation of tensors of the third and fourth rank. 
Archiv d. elektr. Übertragung 5, 1951, 360-362

42) Single response thickness-shear mode resonators using circular bevelled plates. 

43) Mechanical strength of piezoelectric crystals. In co-operation with P. L. Parsons. 

44) An improved frequency equation for contour modes of square plates of anisotropic material. 
Corrigenda, ibid., 555.

45) Elastic and piezoelectric coefficients of lithium sulphate monohydrate. 

46) On thickness vibrations of piezoelectric crystals. 
Archiv d. elektr. Übertragung 5, 1952, 361-368 (September)

47) Piezoelectric resonator quartz and synthetic crystal. 
Telefunken-Ztg. 25, 1952, 229-245 (November)

48) On the fixing and the orientation of crystal plates and the required coordinate transformation. 
Archiv d. elektr. Übertragung 7, 1953, 305-307 (June)

49) The linear piezoelectric equations of state. 

50) Addition to the investigation: on thickness vibrations of piezoelectric crystal plates. 
Archiv d. elektr. Übertragung 7, 1953, 354-356 (July)

51) Dynamic determination of the elastic and piezoelectric constants. 
Telefunken-Ztg. 26, 1953, 102, 355-365 (December)
52) Elastic and piezoelectric coefficients of dipotassium tartrate (DKT). In co-operation with S. Ayers

53) Contour modes of plates excited piezoelectrically and determination of elastic and piezoelectric coefficients.

54) Piezoelectric excited resonance vibrations of plates and rods and dynamical determination of the elastic and piezoelectric constants.
Archiv der elektr. Übertragung 8, 1954, 481-490

55) A few applications of the piezoelectric equations of state.
Archiv der elektr. Übertragung 9, 1955, 122-130


58) Frequency temperature behavior of resonators of natural and synthetic quartz.

59) Electronic grade synthetic quartz.
In co-operation with D. R. Hale
Brush Strokes (Brush Electronics Company, Cleveland, Ohio) 4, 1955, 1-7, (No. 1) (September)

60) Influence of the order of overtone on the temperature coefficient of frequency of AT-type quartz resonators.

61) On the temperature dependency of the frequency of AT- and BT- quartz resonators.
Archiv der elektr. Übertragung 9, 1955, 513-518

62) Variation with temperature of quartz resonator characteristics.
In co-operation with Vera Durana
Proc. Inst. Radio Eng. 44, 1956, 377 (March) (Correspondence)

63) Elastic, piezoelectric and dielectric constants of polarized barium titanate ceramics and some applications of the piezoelectric equations.

64) Flexural mode quartz crystals.
In co-operation with B. Ballato
Electronic Industries, 1956, 52, 53, 92, 93, 15.

65) Frequency-temperature- and piezoelectric constants of AT-type resonators made of synthetic quartz.

66) High-frequency quartz filter crystals.
Proc. Inst. Radio Eng. 46, 1958, 617-618 (March) (Correspondence)

67) Radiation effects in quartz - a bibliography.
Nucleonics, 16, 1958 (March) 122, 138

68) Elastic and piezoelectric constants of alpha-quartz.
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69) Filter crystals.

70) Filter quartz for the frequency range from 7 to 30 MHz.
Archiv der elektr. Übertragung 13, 1959, 90-93 (February)

71) An alternative transformation for the elastic and piezoelectric constants of anisotropic media.
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72) Effect of initial stress in vibrating quartz plates. In co-operation with A. D. Ballato

73) Improved high precision quartz oscillators using parallel field excitation.

74) Excitation of piezoelectric plates by use of a parallel field with particular reference to thickness modes of quartz.

75) The piezo-optic and electro-optic constants of zincblende.

76) Frequency-temperature-angle characteristics of AT- and BT-type quartz oscillators in an extended temperature range.


78) Piezoelectric excitation of thickness vibrating quartz oscillators by means of a parallel field.
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79) Quartz AT-type filter crystals for the frequency range 0.7 to 60 Mc.
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Progress in the field of elimination of unwanted modes in thickness shear vibrating quartz plates in the frequency range 5 to 100 MHz. Jointly with D. R. Curran Archiv der elektr. Übertragung 19, 1965, 499-502 (September, No. 9)

Suppressing unwanted modes in 5-100 Mc/s thickness-shear quartz plates. In co-operation with D. R. Curran Frequency 4, 1966, 18-20 (March-April, No.2)

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2. The elastic, piezoelectric, and dielectric constants of piezoelectric crystals, pp. 40-123

3. Piezooptic and electrooptic constants of crystals, pp. 124-149.


2. R. Bechmann, The Elastic, Piezoelectric, and Dielectric Constants of Piezoelectric Crystals, pp. 40-101


4. R. Bechmann, First and Second Order
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C. Miscellaneous


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