tor is determined by the adhesive force of the cement between the metal and the piezoelectric material. The method of adhesion was experimentally studied and improved, and it was attained, that the adhesive force could overcome the mechanical fore of piezoelectric material. The experimental results showed the adhesive froce to be 420 kg./cm^2. and the tensile strength of piezoelectric material 110 kg./cm^2.

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15. Study on Surface Electricity. (XIV)

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The most important characters of U-effect II in applying it to electro-acoustic devices are the inner impedances of the elements, the frequency characters and the amplitude characters. Elements of the dia. (I) 0.76, (II) 0.49 and (III) 0.37 mm. were used in the experiments, each of which contained 40 mercury — 1 n. HCl aq. interfaces.

The inner impedances of the elements were measured by "Impedance matching method" (*e.g., This Bulletin,* **24,** 12 (1951) *etc.*) to be each 5, 20 and 30 kΩ (at 1,000 c. p. s.) and were inversely proportional to the cross sectional area of the elements.

The frequency characters were measured at constant amplitude of vibration ($1.2 \cdot 10^{-3}$ mm.) with loads obtained above. The results are:

Frequency characters.

Frequency \ Element	I	II	III
2,000 (c. p. s.)	7.9 (mV.)	16.8	21.1
1,000	7.1	20.0	23.7
500	5.6	15.9	23.7
100	2.7	1.8	0.5

Output voltages in mV.

In this experiment free type of vibration was used and elements of large, middle and small cross sections had natural peaks at low, middle and high frequencies, but when piston type is used, flat frequency characters can be obtained. (*This Bulletin,* **20,** 28 (1950)). From this we can deduce that it is better to use elements of small cross section with free type of vibration, in applying this effect to hydrophone of supersonic wave.

The amplitudes of mechanical vibration were measured by frequency modulation method. (*This Bulletin,* **28,** 47 (1952)). The output-amplitude curves at constant frequency were quadratic and gave characters of the so-called

volume expander. The results are:

Amplitude characters at 1,000 c. p. s.

Element / Ampl. of vibr.	I	II	III
$0.3 \cdot 10^{-3}$ (m.m.)	2.4 (mV.)	5.0	6.0
0.7	5.0	11.2	11.9
1.2	9.4	22.4	23.7
1.7	13.3	29.9	35.5

The output voltages in mV.

Lastly, the output voltage increased linearly as the number of the interfaces increased. (*This Bulletin*, **20**, 28 (1950)). This can be seen with the following figures which were obtained with element II at 500 c. p. s. and amplitude of vibration of $2.6 \cdot 10^{-3}$ mm.

Number of interface	4	8	12	16	20	24	28	32	36	40
Load (kΩ)	2	4	6	8	10	12	14	16	18	20
Output volt. (mV.)	4.5	10.6	15.8	22.4	26.6	33.5	37.6	42.2	50.1	59.6

The loads were matched to the inner impedances of the element in every case.

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16. Study on Surface Electricity. (XV)

On Counter U-effect

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Although U-effect is a phenomenon converting mechanical energy of vibration into electrical one, we can make a conversion device in inverse direction by exchanging its acoustic terminals with those of electrical.

(1) U-effect II. We used an element of dia. 0.37 mm. and of impedance 45 kΩ (at 600 c. p. s.), containing 18 Hg-n. HCl aq. interfaces with a piston and an ordinary electrodes. The piston electrode was fixed and the capillary wall was the vibrating part. When an alternating voltage of audio-frequency was fed to the element it began to vibrate and made a sound. The frequency character had a noted peak at 500——600 c. p. s., which seemed to be due to the high stiffness of the damper in this experiment. The me-