Estimates have been made of the mobility of carriers in microcrystalline selenium with carrier densities based on the capacity of rectifiers. In view of the failure of rectifier theory to explain the observed results in selenium rectifiers and the demonstration of the presence of selenium at the intersurfaces of such rectifiers, the results are considered unreliable. The existence of grain boundary resistance in the case of microcrystalline selenium can readily explain the large difference in mobilities of such samples and single crystals.

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**Production of C**

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AND

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January 19, 1950

The bombardment of C⁴ with deuterons has been shown to yield d,p and d,α reactions, both of which were recently reported.¹ We have utilized the larger generator of the Carnegie Institution of Washington to make bombardments with deuterons of energy up to 2.8 Mev in order to look for the C⁴(d,p)C⁵ reaction. The mass estimated for C⁴ is² 15.0165, which would indicate that this reaction would have a Q-value of about ~2 Mev.

A target of BaCO₃ (containing about 40 percent C⁴), of weight about 400 µg/cm², was used in our bombardments.³ A preliminary check showed that, when bombarding with deuterons of 2.4 Mev energy, a beta-emitter of half-life much greater than that of B⁹ was also formed. We were able to measure the half-life by simply following the activity of the target with a stop-watch; counts were recorded after the bombardment beam had been shut off for varying lengths of time. The results of these observations are shown in Fig. 1, where the data for three separate runs have been combined and averaged. All of the sets of data indicated a half-life of 2.4 seconds, with an estimated error of about 0.3 second. Some scatter in the points is probably caused by non-uniformity of the target and slight variations in bombarding current.

When it was established that the half-life is so much greater than that of B⁹ (formed in the competing (d,α) reaction) it was possible to make absorption measurements on the beta-rays from C⁴ decay—again by taking observations directly after bombardment was stopped. It was found that the extrapolated end point of the beta-ray spectrum corresponds to 4.6 g/cm² of aluminum absorber; this would indicate a beta-ray energy of 8.8 Mev, with a tentatively estimated error of about 0.5 Mev. This value of the energy, together with the half-life measurement, indicates that the postulated C⁴→N⁰ decay is a first-forbidden transition.

We have also obtained a rough excitation curve; it rises smoothly with increasing energy of deuterons in the region from 1.4 to 2.8 Mev, except for some indication of a resonance at about 1.9 Mev. This, however, must be confirmed.

The calculated mass of C⁴, based on the beta-ray data, is 15.01434, which makes the Q-value for C⁴(d,p)C⁵ only slightly negative. However, decay of C⁴ may not be to the ground state of N⁰, which would alter this mass value as calculated. Indeed, we have some evidence for delayed gamma-emission.

Bombardment of normal BaCO₃ was also made, and no beta-emitter of appreciable intensity and of half-life comparable to 2.4 seconds was observed.

More complete details of this investigation will be published in the near future.

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**Dependence of the E¹⁹ Nuclear Resonance Position on Chemical Compound**

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January 9, 1950

Most unexpectedly, it has been found that for F¹⁹ the value of the applied magnetic field H₀ for nuclear magnetic resonance at a fixed radiofrequency depends on the chemical compound containing the fluorine nucleus. The assumption has generally been made that the time average of all internal magnetic fields is zero, excluding of course the small diamagnetic field at the nucleus due to the Larmor precession of its atomic electrons in H₀. Nuclear resonance shifts in metals,⁴ interpreted as being due to the conduction electrons, are larger by about an order of magnitude than those reported here.³

To investigate the effect in fluorine, two identical magnetic resonance absorption bridges,⁴ both fed by the same oscillator, were employed. The two sample holders were placed side by side in the magnet so that the F¹⁹ resonance traces occurred simultaneously on separate recording milliammeters. This "null" method allows a precision of about 0.0005 percent of the applied field in measuring relative shifts of resonance position and has been used by the author in measuring such shifts due to the addition of paramagnetic ions.

The maximum separation of F¹⁹ resonances observed so far is 1.05 gauss (see Fig. 1) for CsFCl₂ (froen 113) and BeF₂ in a magnetic field H₀=7000 gauss, the froen resonance coming at the lower applied field. Although the resonances in SbF₃ and BeF₂ are separated by 0.99 gauss when observed in separate samples, the separation reduces to 0.82 gauss for a mixture of the two compounds (see Fig. 2). On the other hand, the resonances in SbF₃ and HF are separated by 0.83 gauss in separate samples, but a half and half mixture of the two results in a single resonance located halfway between the positions where the separate resonances would be expected. Increasing the relative amount of SbF₃ shifts
the single resonance toward the position of the resonance in pure SbF₃. The observed line widths were about 0.15 gauss in all cases. The F⁹⁻ resonance separations in the chemical compounds listed in Fig. 1 were remeasured at a resonance field of 2500 gauss (10.0 megacycles). Within the experimental error, proportionality of the separations with the applied field was found.

It might be added here that a discrepancy exists between the F⁹⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻عكس-

![Figure 1](image1.png)  
![Figure 2](image2.png)

**Fig. 1.** Dependence of F⁹⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻عكس-

![Figure 2](image3.png)

**Fig. 2.** The nuclear resonances of F⁹⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻عكس-

The internal diamagnetic corrections of H'/H₀ for the neutral fluorine atom and the singly charged negative ion have been calculated by the author using Hartree-Fock wave function approaches giving 0.0464 and 0.0472 percent, respectively. Thus for H₀=7000 gauss the effect of the difference between the two diamagnetic fields would be approximately 0.06 gauss. This seems to be the correct magnitude to explain the observed shifts. Further investigation is necessary to determine the nature and cause of these shifts as they progress.

Proton resonances were compared with each other in acetone, mineral oil (Nujol), distilled water, glacial acetic acid, glycerin, and anhydrous ether. No shifts could be detected within the accuracy of the experiment of about 5 parts in 10⁶.

The author wishes to express his thanks to Professor F. Bitter for his advice and guidance during the course of this work.

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**Proceedings of the American Physical Society**

**Minutes of the Meeting at Chicago, November 25 and 26, 1949**

The 295th meeting of the American Physical Society, being the 1949 Thanksgiving meeting, was held at Chicago in the buildings of the University of Chicago on Friday and Saturday, November 25 and 26, 1949. The Secretary thinks that in number of papers (143 contributed!) this was by far the largest meeting yet held west of Washington, D. C. Since by reason of the Thanksgiving holiday it was crammed into two days, the number of papers per day fell short of that of our greatest meetings by about a third, whence the unwelcome necessity of scheduling four and even five simultaneous sessions. In number of people in attendance it fell much shorter of our New York and Washington meetings: the number of registrants, somewhat under 500, is supposed to be not far below the number who actually came. Arrangements were very capably handled by the Local...
Fig. 2. The nuclear resonances of $^{19}F$ in a single sample containing a half and half mixture of SbF$_3$ and BeF$_2$ (saturated aqueous solutions). The applied resonance magnetic field is about 7000 gauss at a radiofrequency of 18.0 megacycles.