tained by establishing which anode wires in an X-Y grid are in closest proximity to the secondary avalanche produced by the passage of a β-particle through a counting gas. By this technique, compounds labeled with ^{3}H, ^{125}I, ^{14}C, ^{32}P, ^{99m}Tc, etc. can be detected with extremely high sensitivity. Two instruments based on this principle (Digital Autoradiograph of Bethold and Instantimager of Canberra Packard) gained popularity for evaluation of chromatoplates.

a. Digital Autoradiograph. The digital autoradiograph (DAR) is a two-dimensional detector that quantitatively measures the position and intensity of two-dimensional distributions of ionizing radiation from a radioisotope on a 20 × 20 cm surface (3,32). The developed TLC plate is placed on a measuring table and then automatically loaded into the detector. The detector consists of three parallel wire planes, with only a few millimeters of space between the planes and between the wires. The central plane is maintained at a positive potential of 1800 V, and the counting chamber is filled with P-10 counting gas (90% argon, 10% methane). The middle plane generates a charge signal from the ionizing radiation entering the chamber. The two orthogonally crossed wire planes below and above the middle plane pick up the signal and thereby determine the position of the radioactivity on the surface measured. The signals from the three wire planes (600 wires) are transmitted via preamplifiers, pulse shapers, discriminators, and logic circuits to analog-to-digital converters and then captured by a suitable data acquisition system.

Signal analysis is achieved by measuring 5 × 360,000 elemental detector cells per second. DAR measurement time (run time) must be optimized on the basis of the amount of radioactivity applied to the plate (11,32). This is accomplished by inspection of the real-time display during data acquisition.

b. Microchannel Array Detector. The microchannel array detector (MICAD) Instantimager of Packard Bioscience (33) consists of two sections, the microchannel array plate and a multiwire chamber. The microchannel array plate is 3 mm thick and has a sensitive area of 20 × 24 cm. It has a laminated surface where conductive (brass) and nonconductive (fiberglass) materials alternate. A voltage step gradient is applied to the successive conductive layers to create a high electric field of approximately 600 V/mm in the microchannels. Above the microchannel array plate is a multiwire chamber similar to that described for the Digital Autoradiograph (anode plane of 200 gold wires approximately 20 μm in thickness; two cathode planes formed by metallic cathode tracks).

The entire MICAD detector is filled with a continuous flow (25 cm^3/min) of counting gas (96.5% argon, 2.5% carbon dioxide, 1.0% isobutane). When a β-particle is emitted from a radioactive source, the counting gas is ionized in one of the microchannels. The electrons produced are accelerated by the high electric field in the microchannel to further ionize the gas to produce a cloud of electrons. In this way, the microchannels serve as both collimaters and preamplifiers. The cloud of electrons migrates up an electric field gradient into the multiwire chamber.

c. β-Imager of Biospace Measures. According to Charpak's original concept, positional information is obtained by establishing which anode wires in an X-Y grid are in the closest proximity to the secondary electron avalanche produced by a β-particle in the counting gas. An alternative approach is the application of a cooled CCD to detect the light emitted by β-particle interactions in a scintillator (34,35). The use of CCD detection makes it possible to enhance the resolution of the image.

This technique is utilized in the β-Imager 1200 (36). Each β-particle that enters the gaseous detector generates an avalanche of electrons and a spot of light. The CCD camera records each event, which is analyzed and stored in a computer system. The detector is similar to that described above. Namely, it consists of two amplification gaps separated by a transfer gap. These gaps are defined by metallic grids and filled with a counting gas mixture (helium, argon, dimethyl ether). When a β-particle enters the detector, it creates a great quantity of electrons by an avalanche process. Two amplification stages result in multiplication of the number of charges from one β-particle at the entrance to 10^5 at the output. The intermediate transfer gap prevents any feedback from the output to the input.

The associated electric field induces a controlled local spark that emits visible light, which is read by the CCD camera. A calculation is performed to optimize the location of the entering