

APPENDIX B.—MANUFACTURERS OF CARDIAC RADIONUCLIDE IMAGING EQUIPMENT AND SUPPLIES

Picker Northford, Corm. (Head office in Cleveland, Ohio)

Background.—Picker is a subsidiary of CIT Corporation. It is one of the oldest companies in the nuclear medicine field and has produced gamma cameras since 1970.

Products.—Scintillation cameras, CAT scanner.
Current Models.—

	<i>Year introduced</i>	<i>List price</i>
DynaCamera 4/15-61 (15" field, 61 photomultiplier tubes, scintillation camera)	1979	\$110,000+
DynaCamera 4 15-37 (15" field, 37 tubes, scintillation camera)	1976	\$96,000-100,000 +
DynaCamera 4/11-37 (11" field, 37 tubes, scintillation camera)	1976	\$90,000
DynaMO (motorized mobile scintillation camera, a 4/11-37 on wheels)	1976?	\$100,000 avg.
DynaCamera 4 (19 tubes)	1974	Discontinued

Market Share.—Claims independent survey of June 1978 to June 1979 sales of scintillation cameras gives Picker 35- to 38-percent market share and first-place ranking.

Customers.—1) Hospitals (ranked: radiology, nuclear medicine, pathology, internal medicine, cardiology); and 2) physicians' offices.

Sales Strategy.—Company prefers to be conservative and tries to maximize the number of standard features, while minimizing add-on accessories. Emphasis on quality control in production raises cost of products. Sales from network of 1 national, 4 regional, and 120 district offices. Advertisements are aimed at physicians. Works with major computer manufacturers to maximize ease of interface.

Future Directions for Company.—In 1979, introduced 7-pinhole tomography with 4/15-61 camera. Predicts that future products will be less expensive, yet will offer better resolution scans. Also researching positron emission tomography, but unsure of economic feasibility.

Future Directions for Radionuclide Imaging.—Features will include higher performance digital computers, better resolution and lower cost. Emphasis will be on improving resolution and sensitivity, better service, and lower price in that order. Respondent sees organizational trend in hospitals toward departments of medical imaging to consolidate administratively nuclear medicine, X-ray, ultrasound, CAT scanning, and other imaging technologies.

General Electric (GE) Waukesha, Wis.

Background.—GE entered the nuclear medicine field in 1972 as a distributor for the Elscint whole-body scanner. In 1975, it bought Nuclear Data, which had just developed the first mobile scintillation camera.

Products.—Scintillation cameras.
Current Models.—

	<i>Year introduced</i>	<i>List price</i>
MaxiCamera 2 System (large-field (16") scintillation camera system, 37 tubes)	1978	\$80,000-\$120,000
MaxiCamera 535 (large-field (24") scintillation camera, 64 tubes)	1978?	?
MaxiCamera 400T (large-field (24") scintillation camera, 67 tubes, for 7-pinhole tomography)	1979?	?
DataCamera (motor-powered, small-field mobile camera, 37 tubes)	1977	\$80,000-\$120,000
PortaCamera 2C (manually moved, small-field mobile scintillation camera, 37 tubes)	1977?	\$65,000
(MaxiCamera 1)	1977	Discontinued
(MaxiCamera)	1976	Discontinued

Market Share.—Claimed 26 percent of scintillation camera market in fiscal year 1978.

Customers.—1) Hospitals (ranked: nuclear medicine, radiology, internal medicine, cardiology); and 2) physicians' offices.

Sales Strategy.—Broad range of models, including PortaCamera 2C for the "van trade" (physicians and technologists who bring the cameras in vans to remote hospitals). Field sales force includes 20 nuclear medicine specialists and 300 X-ray salesmen. Advertising is aimed at physicians through professional journals and medical conventions.

Future Directions for Company.—GE is developing single-photon emission tomography and positron emission tomography equipment.

Future Directions for Radionuclide Imaging.—Respondent foresees more expensive equipment, especially more sophisticated computers. Scintillation cameras will become digital solid-state detectors. Trend toward positron emission tomography and the assessment of cardiac metabolism. Sees organizational trend toward hospital departments of diagnostic imaging, consolidating all imaging functions.

Searle Radiographic 2000 Nuclear Drive Des Plaines, Ill.

Background.—Searle was formed when G. D. Searle, a pharmaceutical manufacturer, bought Nuclear Chicago in the 1960's. First company to manufacture scintillation cameras. Still appears to have largest installed base and largest market share.

Products.—Scintillation cameras, minicomputer, CAT scanner.

Current Models.—

	Year introduced	List price
Pho/Gamma 5 (scintillation camera system)	1977	\$78,000- \$150,000
Scintiview (microprocessor) - Gamma/COR (cardiac probe)	1977	\$49,000 \$15,000
Pho/Gamma LFOV (large-field-of-view scintillation camera)	1976	\$90,000 (avg. depending on collimator(s))
Pho/Gamma LEM (low energy, mobile scintillation camera)	1976	\$85,000 (\$106,500 w/ADAC computer)
Pho/Con-Emission Tomographic Scanner	1975 (updated 1979)	?
Pho/Gamma 37 GP Camera (update)	1974	?

Market Share.—Claimed 1978 market share of 46 percent for scintillation cameras.

Customers.—1) Hospitals (ranked: radiology, internal medicine, pathology, cardiology); 2) clinics; 3) physicians' offices; and 4) commercial laboratories.

Sales Strategy.—Company prefers to wait and introduce well-developed equipment, not to do continual updates. Uses direct sales from main office. Advertising aimed at doctors through professional and trade journals and medical conventions.

Future Directions for Company.—Currently developing lines of single-photon and positron emission tomography in Europe, where cost regulation is said to be less than in the United States. Conducting research on solid-state crystals for photon detection.

Future Directions for Radionuclide Imaging.—Cardiac imaging will continue to increase, especially techniques using technetium. Thallium use will also increase, but more slowly because it is too expensive. Positron emission tomography will increase greatly if prices drop or Government cost controls ease. Respondent sees trend toward easier to use, less expensive equipment.

Ohio Nuclear 29100 Aurora Road Solon, Ohio 44139

Background.—*

Products.—Scintillation cameras, minicomputer, CAT scanner.

Current Models.—

	Year introduced	List price
Sigma 400 Camera (standard field of view)	?	?
Sigma 4105 Camera (large field of view)	?	\$85,000- \$100,000
Sigma 420 Mobile Camera	?	\$125,000

Market Share.—Outside estimate of 1978 market share is 20 to 25 percent (scintillation cameras and systems). Inside estimate is that Ohio Nuclear has two-thirds of the mobile camera market; 122 units sold in fiscal year 1979. Picker and Searle are the competition for mobile cameras. For fixed cameras, Ohio Nuclear has 15 percent of the market.

Customers.—1) Hospitals.

Sales Strategy.—Push mobile cameras. The "Moon Buggy" is the most mobile and reliable mobile unit and is battery powered. Ohio Nuclear software is better than ADAC.

Future Directions for Company.—

Future Directions for Radionuclide Imaging.—Efficiency and resolution of cameras will be improved twofold to threefold.

Raytheon 70 Ryan Street Stamford, Conn. 06907

Background.—Raytheon is a large corporation that appears to be about the fifth largest scintillation camera manufacturer.

Products.—Scintillation cameras, minicomputer.

Current Models.—

	Year introduced	List price
Step 1 (scintillation camera)	1978	Step 1 and
Step 2 (formatter/microprocessor/CRT)	1978	Step 2
		together sell for \$100,000 to \$115,000
XL 91 (large-field-of-view scintillation camera)	1976	

Market Share.—Proprietary.

*Data Incomplete No literature received from company

Customers.—1) Hospitals (ranked: radiology, cardiology); and 2) physicians' offices (only a few radiologists and cardiologists).

Sales Strategy.—Company uses its own field sales force. Advertising is aimed at physicians through professional and trade journals and through business magazines.

Future Directions for Company.—Future products will be more dedicated to specific cardiac imaging uses and less general purpose.

Future Directions for Radionuclide Imaging.—Respondent feels market for cardiac imaging is "growing by leaps and bounds." Sees future products easier to use, less expensive to purchase, less expensive to operate, and more dedicated to thallium and technetium cardiac studies.

**Baird Corp.
Cordis Nuclear Medical Systems
125 Middlesex Turnpike
Bedford, Mass. 01730**

Background.—Baird was the second company to manufacture scintillation cameras (beginning in 1965) and an early developer of the multicrystal camera (about 1972). Company has not been able to capitalize on the market share advantage provided by its early entry into the field. There are 100 systems in the field at present, but only 12 were sold in 1978.

Products.—Scintillation camera system,

Current Models.—

	<i>Year introduced</i>	<i>List price</i>
System 77 (scintillation camera system with Keronix computer)	1972	\$99,500- \$190,000

Market Share.—Proprietary. Only producer of multicrystal camera for "first-pass" studies.

Customers.—Hospitals (ranked: radiology, nuclear medicine)

Sales Strategy.—Refined single model distributed by Cordis.

Future Directions for Company.—Will continue to produce the System 77 with updates.

Future Directions for Radionuclide Imaging.—Opinion not expressed.

**Union Carbide
Medical Imaging Division
333 Providence Highway
Norward, Mass. 02062**

Background.—Union Carbide is a large corporation that entered the nuclear medicine field in 1976

when it purchased Cleon, a company that had just developed a CAT scanner.

Products.—Scintillation camera, minicomputer, single-photon tomographic imager.

Current Models.—

	<i>Year introduced</i>	<i>List price</i>
Union Carbide Cleon 711 (radionuclide body function imager for single-photon tomography)	1979	\$398,000
Union Carbide Cleon 720 (large-field gamma camera)	1977	\$70,000
Union Carbide Cleon 110 (image processor, minicomputer)	1977	\$50,000

Market Share.—Proprietary, but claims Union Carbide is in fifth place in scintillation camera and systems sales.

Customers.—1) Hospitals (ranked: nuclear medicine, radiology); 2) physicians' offices (few); and 3) clinics (few).

Sales Strategy.—Union Carbide uses its own regionally based sales force. Advertising is aimed at physicians through professional trade journals and meetings.

Future Directions for Company.—Into single-photon tomography market. Will continue research and explore new markets.

Future Directions for Radionuclide Imaging.—There will be new capabilities in cardiac imaging, especially from improved data processing. Resolution of scans will not increase much, as cameras are operating at their limits of resolution (about 1/10") now. The Anger-type scintillation camera will continue in use for about 5 years. The present market is mature, with stable prices through competition and comparable products. The use of CAT scanning in cardiac diagnosis will increase during the next 5 years.

**ADAC (Analytical Development
Associates Corp.) Laboratories
255 San Geronimo Way
Sunnyvale, Calif. 94086**

Background.—ADAC Laboratories is a California company that has been manufacturing computers for medical use since the mid-1970's. ADAC is perhaps the leader in computers for nuclear cardiology.

Products.—Minicomputers for nuclear imaging.

Current Models.—

	<i>Year introduced</i>	<i>List price</i>
Clinical Acquisition Module 11 ? (mobile minicomputer for		\$40,000 (base)

imaging data collection and manipulation)		\$50,000 (avg.)
Clinical Acquisition Module (mobile minicomputer for imaging data collection)	1976?	
Clinical Data System (stationary minicomputer)	1976	\$50,000 (base) \$75,000 (avg.)

Also: a Remote Terminal, a Modem to transmit data over telephone lines, a Multiformat Camera to transfer images or curves to X-ray film, a high-speed Disk Drive, a Fortran IV compiler on which users can write their own software, and a number of software packages including 7-pinhole tomography.

Market Share.—Proprietary, but claims to and appears to be ranked first in sales for minicomputers, though may be tied with Medical Data Systems.

Customers.—1) Hospitals (ranked: radiology and cardiology); and 2) private radiology and cardiology laboratories and practices.

Sales Strategy.—Not described. Company advertises in professional journals and at conventions.

Future Directions for Company.—Continue research. Nuclear cardiology is company's biggest application. Developing software for 7-pinhole tomography. Also developing software for 7-pinhole gated blood pool tomography.

Future Directions for Radionuclide Imaging.—Not discussed.

Medical Data Systems (MDS) Division of Medtronic, Inc. 2311 Green Road Ann Arbor, Mich. 48105

Background.—MDS is an established leader in the computer segment that maintains its software capabilities are second to none. The company pioneered MUGA (multiple-gated-acquisition) studies.

Products.—Computer systems.

Current Models.—

	Year introduced	List price
Modumed	1972	
Az	1972	\$53,000

Market Share.—400 Modumed systems in the field, and 60 Az units sold since January 1979. Has production problems and a current 90- to 120-day delay in meeting orders. Major competition is ADAC. Virtues of the Az model include a hard disc and minicomputer (versus ADAC's floppy disc and microprocessor) and the ability to acquire and process more than one study simultaneously.

Customers.—1) Hospitals; and 2) physicians' offices.

Future Directions for Company.—Improved software and trend toward larger central processing units.

Digital Equipment Marlborough, Mass.

Background.—Digital Equipment is a large minicomputer firm producing computers for nuclear medicine applications.

Products.—Minicomputers for nuclear medicine data applications.

Current Models.—

	Year introduced	List price
Gamma 11-1134 Processor* (minicomputer for use with scintillation cameras)	1976	\$54,000
MDA-11 (mobile unit)	?	?

* Includes 128 Kiloword memory, DEC terminal, video terminal, Anger camera interface color video ability, operating system, software, installation, operator training, 90-day's service.

Market Share.—Proprietary, but claims to be leader in nuclear medicine computers worldwide, with more than 500 systems installed, many in research institutions.

Customers.—1) Hospitals (ranked: radiology, nuclear medicine, cardiology); and 2) clinics.

Sales Strategy.—Not discussed. Advertisements in professional journals aimed at physicians.

Future Directions for Company.—Continued research to develop hardware and software for present and new cardiac imaging technologies.

Future Directions for Radionuclide Imaging.—Respondent sees two diverging trends in hardware: 1) use of large central computers to process input from one or more small remote computers; and 2) increasing use of portable self-contained units. Thinks future belongs to tomography, but not sure which tomographic technique. Seven-pinhole is the easiest to perform, but the new revolving-head cameras for radionuclide tomography (Searle Pho/Con, GE, Union Carbide) will compete.

Mallinckrodt Nuclear 675 Brown Road Hazelwood, Mi. 63042

Background.—Mallinckrodt is a large chemical producer that has been involved in nuclear medicine for many years. The company sold contrast media before buying Nuclear Consultants in about 1965. It then started making and selling its own line of radiochemicals.

Products.—Technetium generators, gallium, thallium (introduction imminent), cold mix agents.

Current Models.—

	<i>Year introduced</i>	<i>List price</i>
Ultratechnical Tc99m Generator (in 8 steps of increasing radiation specific activity from 250 mCi to 3 Ci)	1965	\$160-\$500 (depending on specific activity)
Techniscan (pyrophosphate cold mix)		\$71 .50/kit
Gallium generators		

Market Share.—Proprietary. Respondent claims Mallinckrodt and Squibb are tied for first place in sales of technetium generators and that Mallinckrodt sells over 1,000 generators per week, Mallinckrodt is first overall in radiopharmaceuticals.

Customers.—Hospitals (ranked: radiology, nuclear medicine).

Sales Strategy.—Not discussed. Advertisements are aimed at physicians through professional journals.

Future Directions for Company.—Mallinckrodt will soon introduce thallium and a kit to determine cardiac enzyme (CPK) levels to diagnose acute myocardial infarctions. Thallium will probably be produced in Holland initially and transported to distribution centers in the United States.

Future Directions for Radionuclide Imaging.—Not discussed.

Squibb Hospital Division P.O. Box 4000 Princeton, N. J. 08540

Background.—Squibb is a large pharmaceutical firm that has produced radionuclides since about 1963.

Products.—Technetium generators, cold mixes.

Current Models.—

	<i>Year introduced</i>	<i>List price</i>
Technethium-99m Molybdenum Generator (in 6 steps of increasing radiation specific activity from 220 mCi to 2.2 Ci)	1963	\$100-\$300 (depending on specific activity)
Phosphotec (pyrophosphate for labeling with Tc-99m)		
Macrotec (albumin for labeling with Tc-99m)		

Market Share.—Respondent claims Squibb is leader in generator and cold mix sales, with 50 percent of the market.

Customers.—1) Hospitals (ranked: radiology, cardiology, pathology, internal medicine); and 2) physicians' offices (radiologists, cardiologists).

Sales Strategy.—Squibb employs its own field sales force. Production facilities are on both coasts of the United States, in New Brunswick, N. J., and in Los Angeles, Calif. Advertising is aimed at physicians and hospital administrators in medical, professional, and trade journals.

Future Directions for Company.—Seeking approval to introduce thallium.

Future Directions for Radionuclide Imaging.—Market is still growing. Respondent thinks technetium will replace the cyclotron-produced thallium, as it replaced cyclotron-produced fluoride in bone imaging. Reasons are the lower cost and lower radiation dose of technetium compared to thallium.

New England Nuclear (N EN) Medical Diagnostics Division Bedford, Mass.

Background.—NEN has been a producer of isotopes and radiopharmaceuticals since 1956. The company owns four cyclotrons and is the sole source of thallium approved for human use in the United States.

Products.—Thallium, technetium generators, cold mixes, other radioisotopes.

Current Models.—

	<i>Year introduced</i>	<i>List price</i>
Thallous Chloride-201 (1.65 mCi, thallium for cardiac scanning)	1977	\$93.50 (dose)
Technetium Generator (in 8 steps of increasing radiation specific activity from 225 mCi to 2.7 Ci)	1967	\$169-\$776 (depending on amount)
Pyrolite ("hot spot" imaging agent for labeling with technetium)	1977?	\$483 (30 vials)
Cardiolite (human serum albumin imaging agent for labeling with technetium; not FDA approved for human use)	1977?	—

Market Share.—100 percent of market for thallium (sole U.S. source). Respondent claims that NEN is even with Mallinckrodt and Squibb in technetium generator sales, with each company having one-third of the market. In cardiac cold kits, these companies are all tied for second position behind Union Carbide.

Customers.—1) Hospitals (ranked: radiology, internal medicine, cardiology, pathology); and 2) physicians' offices (increasing).

Sales Strategy.—NEN employs an international field sales force in the United States, Japan, South America, Europe, India. Salespersons coordinate cardiologists and nuclear medicine specialists with the supplier. Advertising in professional journals and at conventions.

Future Directions for Company .—NEN is evaluating radionuclides with improved energy characteristics and reduced radiation dose.

Future Directions for Radionuclide Imaging.—Respondent predicts considerable growth in use of thallium for the next years. Predicts considerable future use of positron emission tomography due to its desirable scanning characteristics and reduced radiation dose. Active research into development of new isotopes with long-lived parents and short-lived (1 to 30 minutes) products of appropriate energy.

Medi + Physics (a subsidiary of Roche Pharmaceuticals) Emeryville, Calif.

This company markets "instant technetium," a ready-to-use form for labeling cold mix imaging agents. The 6-hour half-life of the isotope necessitates same-day delivery to users. This form is popular on the west coast, where it is provided by Medi + Physics and a number of smaller radiopharmacies.

Procter and Gamble Cincinnati, Ohio

This company manufactures one product for use in radionuclide scanning, "Osteoscan," a cold mix agent used for bone imaging but also approved for "hot spot" myocardial infarction imaging.

Union Carbide Clinical Diagnostics Division Tuxedo, N.Y.

Background.—Union Carbide is a large, diversified chemical company that was able to enter the radionuclide market through possession of a reactor for economic production.

Products.—Technetium generators, cold imaging agents.

Current Models.—

	<i>Year introduced</i>	<i>List price</i>
CintiChem Moly-99m- Technetium-99m Generator (in 5 steps of increasing radiation	1972	\$180-\$360 (depending on amount)

specific activity from 500 mCi
to 2.5 Ci)

CintiChem HSA (human serum 1972
albumin imaging agent for
labeling with technetium)

Market Share.—Respondent states that Union Carbide is ranked third in sales of technetium generators (after Mallinckrodt and New England Nuclear) with 20 percent of the market.

Customers.—1) Hospitals (ranked: radiology); 2) physicians' offices (a few radiologists); 3) clinics (radiologists); and 4) radiopharmacies.

Sales Strategy.—Union Carbide employs its own field sales force from regional offices, and orders can be made directly to the main office as well. Advertising is aimed at physicians through professional journals and at conventions.

Future Directions for Company .—Not discussed.

Future Directions for Radionuclide Imaging.—Not discussed.

Ancillary Equipment Producers

The following three companies are included to describe the range of products in this segment. They are not intended to be a representative sample of the hundreds of ancillary equipment producers.

**Harshaw Chemical Company
Crystal and Electronic Products
Division
6801 Cochran Road
Solon, Ohio 44139**

This company is a manufacturer of components for scintillation cameras. It produces the detectors and sells them to the camera producers. Its main customer is Searle; companies in the second rank of Harshaw clients are Picker, Pfizer, Ohio Nuclear, GE, and Raytheon. The company began producing scanner parts in 1955-60. Respondent considers that radionuclide imaging in the future will be characterized by equipment that is more technician-oriented, easier to use, capable of faster scans with better resolution, and exposes the patient to a lower whole-body radiation dose.

**Med-X, Inc.
Palatine, Ill.**

This company specializes in servicing and upgrading older Searle scintillation cameras. It makes and installs two models of improved detectors, the X-7 and the X-37 Super Resolution. These detectors improve resolution from 3/16" to about 1/10" or better.

The new detectors cost from \$19,000 to \$25,000, including 1 year of service. Meal-X was started by former Searle employees and has been making updates since 1975. The firm's largest customers are hospital purchasers of used scintillation cameras. Meal-X also performs scanning for rural hospitals on a per-scan charge basis. The respondent predicts that the future of medical imaging will be a competition among competing modalities, with scanning, ultrasound, and other technologies all improving constantly.

**Eastman Kodak
Health Sciences Division
State Street
Rochester, N.Y.**

This large photographic and chemical company makes X-ray and other sheet film to produce the hard copy of selected images from cardiac radionuclide studies. From one to many pictures up to 8" x 10" may be taken during each study for viewing by physicians and/or for the patient's record.