vised to obtain successive images of the distribution of a radioactive tracer within the body after intravenous injection of the tracer. Thus it is used widely in conjunction with the diagnostic tracer techniques described earlier (thallium-201 and technetium-99*m*), representing 80 percent of all *in vivo* studies in nuclear medicine. About one in four patients in American hospitals undergoes an examination with the scintillation camera as part of the process of medical diagnosis. Almost 7000 cameras are now being used in hospitals of all sizes in the United States, and 3000 of these are used in conjunction with computers to enhance the images produced.

Scanning Instruments The familiar CAT Scan (Computer Assisted Tomography Scanning) is a vital tool in medical diagnosis, yielding three-dimensional views that reveal body structure in striking detail. However, because CAT Scans cannot depict the active functioning of body organs, there was a further need for a device that could provide such views of regional physiological processes, such as blood flow and metabolism. This led to the development of the PET (Positron Emission Tomography) scan and the use of short-lived radioisotopes of elements that occur naturally in the body (e.g., oxygen, nitrogen, and carbon). Once these radioisotopes are injected and become distributed, their positron emissions are attracted to electrons associated with the normal matter in the body. Both particles are thus annihilated, and a new form of energy is emitted which can be detected by the PET scanner. This information is processed by computer to reconstruct images of the internal distribution and movement of the radioisotope and thus the functioning of the organ of interest. Several companies now manufacture the PET scanner at costs of about $1 million per unit. This instrument is considered to be enormously valuable in diagnosing and understanding diseases of the brain (e.g., cancer, mental diseases, epilepsy) and of the heart and lungs.

Instrument Standardization Nuclear instruments, including those used in nuclear medicine, are produced by many manufacturers and at one time were not compatible electrically or mechanically. In any new situation it was often necessary either to forego the use of instruments on hand or to replace them with compatible units at considerable cost. Under the nuclear medicine program, a modular nuclear instrument system was developed to provide mechanical and electrical power supply interchangeability. Other compatible modules were designed to feed signals from these instruments to computers and other processors and associated software. These concepts were adopted by standards-setting institutions and manufacturers and have been promulgated worldwide. Annual U.S. sales of the modular and automated systems amount to $23 million and $17 million, respectively, and represent 50 to 60 percent of the world market.

Treatment

Hyperthyroidism Hyperthyroidism, characterized by excessive levels of circulating thyroid hormones, can be marked by a variety of clinical conditions, including increased metabolic rate, enlargement of the thyroid gland, rapid heart rate, and high blood pressure. The three major treatments for this condition (surgery, drugs, or iodine-131 therapy) focus on destroying the abnormal thyroid tissue that is producing the excess hormone. Surgery to remove the thyroid gland is painful and expensive and carries risks. The use of drugs requires long-term treatment, incurs possible side effects, and may eventually end in surgery. However, it was found in the early 1940's that the iodine-131 radioisotope concentrates in the thyroid gland, and a means to destroy overactive tissue through short-range particle emissions was thus provided. The early discovery of this treatment and its selectivity are evident from the fact that, from the mid-1940's to the late 1960's, iodine-131 was the principal radioisotope used in nuclear medicine. For almost 50,000 persons each year in the United States who undergo iodine-131 treatment in place of surgery, the annual savings in terms of productive time and lower medical costs have been computed to be $280 million.

Parkinson's Disease Parkinson's disease, a debilitating neurological disease, afflicts close to one million persons, with 50,000 new cases per year. In two-thirds of the cases, the onset of symptoms occurs between the ages of 50 and 70 and becomes progressively worse. In the early 1950's, several radioisotopes, particularly manganese-56, were used to investigate a possible link between trace metals and this disease. Although no conclusive connection could be made between the disease and manganese poisoning, several new areas of research evolved from these studies. Eventually, it was found that there is a deficiency of an amino acid, dopamine, in the brains of persons suffering from Parkinson's disease and that this amino acid could be synthesized internally after intravenous injection of a related compound, L-dopa. The treatment does not cure the disease but can mitigate the severity of its progression. It produces initial improvement in 50 to 75 percent of the cases, slows the rate of advance of the disease, and decreases the mortality rate. Thus the benefits of this treatment can be measured in terms of improved quality of life (i.e., increased years of work and independence and a decreased or postponed period of incapacity) with an average increase of 2.5 person-years of active or productive time per person afflicted. Based on 50,000 new cases per year in the United States, this translates to a gain of approximately 125,000 person-years of active life annually.