they have been completed. Although Neirinckx and Davis may ultimately prove correct in their negative appraisal of our generator, we have not as yet formed an opinion on this matter and believe it to be presumptuous of them to have done so already.

It is also not clear where Neirinckx and Davis obtained their value of 0.5% Ge-68 loss for our generator. Such a loss would indeed be a problem if it were true, but we have not observed that to be the case.

At any rate, it appears that the need for a good biomedical generator for ionic Ga-68 still exists. Although no actual performance parameters were reported (*1*), the low elution yield of Ga-68 and small $K_D$ of Ge-68 on the proposed $SiO_2$ column would translate to relatively poor Ga/Ge separation factors and would also require frequent generator reconstruction. Moreover, the use of $HNO_3$ eluent is very unattractive, and the compulsory post-elution evaporation step would result in a significant loss of effective Ga-68 yield through physical decay (similar to that incurred in the destruction of the Ga-68 EDTA chelate eluted from today's commercial generators).

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## Reply

We appreciate the interest of Drs. Grant, O'Brien, Mirzadeh, et al. in our manuscript and are distressed that they have the impression that we have condemned their distillation generator to failure. Our exact words were "the more complicated nature of the distillation procedure makes this more useful in a research environment than in a typical hospital setting." Neither extraction nor distillation techniques are well suited to the routine production of radioactive generators, since both are cumbersome and require chemical expertise. Given the present state-of-the-art in generator technology and the knowledge of past attempts with distillation or extraction systems, we are content to stand by our initial statement. During the early to mid 1970s, an attempt was made to commercialize a Mo-99m→Tc-99m generator based on a solvent extraction-evaporation principle (Mek-Tec). The system was fully automated, could be activated either by a preset timer or by remote signal, and allowed reconstitution to any desired concentration. The needs to restock the Mo-99 weekly in the laboratory, to connect several pieces of tubing properly, and to ensure complete removal of the solvent (MEK) were met with extreme skepticism by most of the nuclear medicine community and the "product innovation" failed. More recently, Erhardt and Welch reported on the preliminary development of an extraction generator for Ge-68→Ga-68 using oxine (*1*). Upon scaleup to larger-sized units (>20 mCi) they found that radiolysis of the solvent gave rise to impurities that significantly decreased or totally inhibited gallium labeling or complex formation (M. J. Welch, personal communication).

The Ge-68 loss figure quoted in our paper (0.5%) was obtained from an oral presentation by one of the authors (*2*), and we understand that this figure has since been appreciably lowered by using higher activities of Ge-68.

As we conceded in our article, the $SiO_2$-based system suffers from the necessity of completely removing the $HNO_3$ from the eluate. We agree that the need for a good biomedical generator still exists. For this reason our program has progressed beyond the $SiO_2$-based column to the development of systems based on either an organic anion-exchange resin (*3*) or a synthetic germanium-specific chelate resin (*4*). Admittedly we have no experience with the distillation procedure, but it is our belief that these procedures, no matter how easy, cannot match the convenience of a simple eluate collection from a chromatographic system.

Taking into account the desirability of a chromatographic system on an inorganic adsorbent, we feel that the best system to date (assuming it is reproducible) is the one based on adsorption on $ZrO_2$ from dilute hydrochloric acid as described by Malyshev and Smirnov (*5*) in 1975.

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## Usefulness of Liquid Radioiodine in Avoiding Factitious Low I-131 Uptake Studies

We recently encountered a patient with severe toxic goiter (Graves' disease) who caused serious confusion, apparently by disrupting our I-131 uptake tests. A 16-year-old girl was referred for management of severe hyperthyroidism. Physical examination revealed a pulse rate of 128/min, tremor, and a thyroid diffusely enlarged to three times normal size. After i.v. administration of 8.7 mCi of [$^{99m}$Tc] pertechnetate, the gamma image revealed rapid and uniform tracer uptake. The serum-free thyroxine index was 16.5 (normal 1.4-4.0) and the serum $T_3$ (RIA) >800 ng% (normal

60-190 ng%). The diagnosis of toxic diffuse goiter (Graves' disease) was made and the patient was started on propylthiouracil, 200 mg q.i.d. along with propranolol hydrochloride, 20 mg q.i.d. To our surprise, 6 wk later, the patient was still clinically toxic, and discussion with relatives revealed that she was not taking her thyroid medications regularly. They indicated that they could not control her behavior adequately to assure us that she would take her medications conscientiously. For that reason, we elected to treat this patient more definitively with I-131. A urine pregnancy test was ordered and the patient presented a water-like liquid for study. A second request for a urine specimen produced a yellow fluid more typical of urine. A radioiodine uptake from a 5-$\mu$Ci I-131 capsule was <1% at 24 hr. However, the number of counts over the thyroid area was over 2.5 times our normal background reading. We repeated the uptake and even more closely observed the patient ingesting the radioiodine capsule. The uptakes at 1, 2, 4, and 24 hr, however, were all <1%. Again, all of these counts were significantly greater than background. There was no significant tracer uptake over the ovaries. The 24-hr urine iodine was 84 $\mu$g (normal 150-700 $\mu$g/24 hr).

A 24-hr urine showed that <1% of the radioiodine was present. This point confused us greatly. If the radioiodine was present to only a slight degree in the thyroid and not in the urine, where could it be? We then suspected that the low uptake results were factitious. To test this hypothesis we repeated the patient's uptake, administering liquid I-131. The uptake was then 45% at 1 hr and 64% at 24 hr. Twenty-nine mCi of liquid I-131 was then administered orally. The patient's goiter promptly regressed, as did her hyperthyroidism.

One of us (SSS) has previously served as physician at a federal narcotics hospital. Whenever possible, all medications in that institution were administered either in liquid form or by the parental route in an effort to avoid the problem of contraband medication. Patients given capsules or tablets would sometimes put the medication between the cheek and gum and later remove this medication for the "market place." We guessed that if the current patient had carried out a similar maneuver, enough absorption could occur to provide trace amounts of radioiodine over the thyroid area, and this could explain our previously confusing results. The prompt and intense radioiodine uptake observed after administration in liquid form provided support for our suspicion. In retrospect, we might have measured uptake levels over the stomach and mouth after apparent capsule ingestion. This could be a practical approach if liquid radioiodine is not available.

Although the patient repeatedly refused to admit that she did not swallow the entire capsule, this seemed to be the most reasonable explanation. The manufacturer of the I-131 capsule in question, assured us that no reports of failure of I-131 uptake have been reported because the material was given by capsule. Although we have administered many thousands of I-131 capsules in our laboratory, we have never seen a serious problem of capsule malabsorption, so such events, if any, must be exceedingly rare. We must conclude that this patient in all likelihood surreptitiously ejected the I-131 capsule at some time after putting it in her mouth.

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## Accepted Gallium-67 Decay Data

The industrial and government members of the Atomic Industrial Forum Research Associate Program have agreed to the following decay data for gallium-67.

The AIF-sponsored Research Associate Program is supervised and administered by the National Bureau of Standards for the member industrial companies in an effort to unify the nuclear decay data and maintain equivalent millicurie values for the major radiopharmaceutical manufacturers.

**TABLE 1. Ga-67 EC DECAY* (78.26 H 3)**
**I (MIN) = 0.10%***

| Radiation type | Energy (keV) | Intensity (%) | Δ(q-rad/μCi-hr) |
|---|---|---|---|
| Auger-L | 0.99 | 168 9 | 0.0035 |
| Auger-K | 7.53 | 61 4 | 0.0098 |
| ce-K-1 | 81.607 5 | 0.224 9 | 0.0004 |
| ce-K-2 | 83.652 5 | 28.7 13 | 0.0511 |
| ce-L-2 | 92.117 5 | 3.52 15 | 0.0069 |
| ce-M-2 | 93.175 6 | 0.516 22 | 0.0010 |
| ce-K-3 | 174.918 10 | 0.40 5 | 0.0015 |
| X-ray L | 1 | 0.8 4 | ≈0 |
| X-ray $K\alpha_2$ | 8.61578 5 | 16.8 12 | 0.0031 |
| X-ray $K\alpha_1$ | 8.63886 5 | 32.9 23 | 0.0061 |
| X-ray $K\beta$ | 9.57 | 6.7 5 | 0.0014 |
| $\gamma$ 1 | 91.266 5 | 3.07 10 | 0.0060 |
| $\gamma$ 2 | 93.311 5 | 38.3 12 | 0.0760 |
| $\gamma$ 3 | 184.577 10 | 20.9 6 | 0.0823 |
| $\gamma$ 4 | 208.951 10 | 2.37 7 | 0.0105 |
| $\gamma$ 5 | 300.219 10 | 16.8 4 | 0.107 |
| $\gamma$ 6 | 393.529 10 | 4.70 14 | 0.0394 |
| $\gamma$ 10 | 887.693 15 | 0.145 5 | 0.0027 |

3 weak $\gamma$'s omitted ($\Sigma I\gamma$ = 0.13%)

* National Council on Radiation Protection and Measurements, Handbook of Radioactivity Measurement Procedures, NCRP Report No. 58, November 1, 1978.

Since January 1978, intercomparison studies have been completed on standards of gallium-67, based on the decay scheme issued by the Nuclear Data Group of the Oak Ridge National Laboratories as part of the Evaluated Nuclear Structure Data File (ENSDF) program. This nuclear decay data can be found in NCRP Report 58.

A new issuance of the gallium 67 standard will be available in July 1980, from the National Bureau of Standards, based on the decay data shown above.

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Chairman
AIF/NBS Steering.
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## Kinetics of Thyroidal Uptake of Pertechnetate

In recent articles, Hays (*1-3*) has used a model with two intrathyroidal compartments to describe thyroidal uptake of pertechnetate in the normal and diseased gland. A two-compartment model was introduced because a single-compartment model (*4*) could not produce a computed uptake curve that adequately fitted experimental data. The two compartments consist of a fast ("follicular cell") compartment, which equilibrates instantaneously with plasma, and a slower ("colloid") compartment. A plasma tracer curve, based on venous blood samples, was used in the computational procedures. No consideration appears to have been