population studied here, no liver metastasis was large enough to appear as a cold lesion. Among the first patients studied with iodine-123- (^{123}I) labeled anti-CEA MAb fragments (*2*), we have observed photopenic areas in the presence of very large metastases, at least at 6 (and eventually 24) hr, but even in these patients the tumors showed uptake of MAb fragments at 48 hr.

In patients with no definite diagnosis of recurrence, we have demonstrated that RIS was able to identify 16/38 (42%) tumor sites, which could not be detected by other methods during the concomitant diagnostic work-up. Among these 16 lesions, there were 7 liver metastases and 6 local recurrences, as well as 2 lung and 1 peritoneal involvements. This seems to answer your second question. In our opinion, the present clinical value of RIS in colorectal carcinoma lies mainly in the early detection (and confirmation in case of equivocal US or CT studies) of local recurrence. To this may be added the early diagnosis of liver metastases when RIS is performed with ^{123}I labeled MAb. Our own experience with the ^{99m}Tc-labeled anti-CEA MAb BW 431/26 (*3*) is comparable to your results. We also observed excellent detection rates in primary tumors and local recurrences but did not obtain reliable data in the detection of liver metastases. With ^{99m}Tc BW 431/26 (intact MAb), we recovered in one patient 0.0001% of the injected activity (ID) per gram of liver tumor which had been resected at 24 hr. In patients studied with the ^{123}I-labeled anti-CEA MAb 25, administered as F (ab')$_2$ fragment, the order of magnitude of activity recovered in liver metastases was 0.01% ID/g.

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A. Bischof-Delaloye
Centre Hospitalier Universitaire Vaudois
Lausanne, Switzerland

Starport Digital Gamma Camera

TO THE EDITOR: A recent issue of *The Journal of Nuclear Medicine* contains a report by Freitas et al. on a problem that had appeared in a Starport 500A digital camera system manufactured by General Electric Company.

The "chronology of events" recounted by the authors was accurate as far as it was reported. However, the cause of the problem was subsequently identified and its successful resolution did occur. Furthermore, the authors themselves played a key role in this successful resolution.

The first Starport digital gamma camera was installed in December 1985. More than 200 systems were in service and functioning satisfactorily when the authors notified GE about an intermittent occurrence of a display of the name of one patient with the image of another. Since this effect had been reported only by the authors' institution, it was at first believed to be the result of a hardware malfunction. After repeated unsuccessful attempts to locate the source of the problem, the entire electronics console was replaced. The paper reports that since then (i.e. April 27, 1988), ". . . the problem of switching images and patient identification text has not been observed."

The paper failed to recount subsequent developments. In May 1988, the same problem did recur, but this time a sequence of actions was identified that enabled the GE software engineers to isolate a "bug" in the management of the image memory. A revised release, provided to the authors' institution on August 4, 1988, was tested and found to have successfully resolved the problem. After further thorough testing of the new software release (designated Starport Release 4.4), it was sent to *all* Starport installations in December 1988. The release included a detailed description of the problem and its resolution.

It must be noted that even though the *Journal*'s paper was not submitted until December 1988, and later revised in April 1989, the authors chose not to include a description of the events since May 1988: namely, GE's isolation of the problem, its resolution, the validation of the solution at the authors' institution, and distribution of updated software to all users of these systems.

The lesson of all this is clear. Although GE, like other vendors, devotes considerable efforts to validating its software, some residual "bugs" may go undetected. Both hardware and software malfunctions occasionally occur. Vendors have an obligation to expeditiously work with users to bring matters such as this to a successful conclusion, which will be beneficial to the patients and to other customers.

GE thanks the authors for bringing this problem to its attention and for the confidence they expressed in GE nuclear medicine products by ordering two additional systems.

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Tsur Bernstein
GE Medical Systems
Milwaukee, Wisconsin

REPLY: Dr. Bernstein takes us to task for failing to continue the narrative past April 27, 1988. In May 1988, the problem of mismatched displays did recur, but modifications of the imaging protocol did not allow us to record the image on film. Thus, there was no possibility of observer misinterpretation of clinical images. Dr. Bernstein goes on to classify the image switching problem as a software malfunction that was corrected in subsequent Starport software (Version 4.4) releases received in December 1988. This information (sent in a *"Dear Customer"* letter despite our many contacts) was not brought to my attention prior to approving our April 1989 revision.

Our article was not intended to be a blow-by-blow account of the resolution of the problem. Our goal was to alert colleagues to a situation that could lead to inappropriate patient care and to offer our suggestion for detecting such a problem and preventing image misinterpretation. Although, we may have been the one institution to report this problem to the manufacturer, personal communications from other institutions have assured us that we were not the only institution to note the malfunction.

We thank Dr. Bernstein for his interest in our publication and for clarifying the cause of the image switching malfunction noted.

John E. Freitas
William Beaumont Hospital
Royal Oak, Michigan

Statistical Artifact in DPA Measurements at Low Count Rates

TO THE EDITOR: I would like to offer a possible explanation for the apparent increase in bone mineral content (BMC) observed by DaCosta et al. (*1*) at low counting rates. The increase amounted to ~0.04 g/cm^2 for an aluminum "bone phantom" scanned in 24.5 cm of water, with a 0.3-Ci source and "narrow" (8-mm) detector collimation on a Lunar DP3 scanner. Although counts per pixel were not specified, the conditions described suggest that they were "small." A statistical artifact that occurs in low-count data may explain the effect.

The equation for computing BMC, BMD (g/cm^2), is given by (*2*):

$$BMD = CF\,(A_b - A_s), \quad (1)$$

where

$$A_b = R\,\ln(N_{hb}) - \ln(N_{lb}) \quad (2)$$

$$A_s = R\,\ln(N_{hs}) - \ln(N_{ls}) \quad (3)$$

$$R = u_{sl}/u_{sh} \quad (4)$$

$$CF = 1/(u_{bl} - R\,u_{bh}) \quad (5)$$

In the above equations, N_{hb} and N_{lb} are the high- and low-energy photon counts measured through bone, N_{hs} and N_{ls} are the counts measured in the soft-tissue baseline, u_{bh} and u_{bl} are the mass attenuation coefficients of bone mineral at the high- and low-photon energies, and u_{sh} and u_{sl} are the corresponding quantities for soft tissue.

In practice, A_b and A_s are measured at many points and averages are taken to compute the patient's average BMD. Random variations in count rate occur from point-to-point due to statistical fluctuations in source decay. Implicit in the averaging procedure is the assumption that the mean of the observed counts equals the "true counts" and that mean of the logarithm of the observed counts, N, is equal to the logarithm of the mean, m:

$$\langle \ln(N) \rangle = \ln(m). \quad (6)$$

This assumption generally is not valid, because a statistical fluctuation of one count below the mean causes a greater discrepancy in the logarithm than a fluctuation of one count above the mean. For example, ln(10) = 2.303, whereas the mean of ln(9), ln(10), and ln(11) is 2.299.

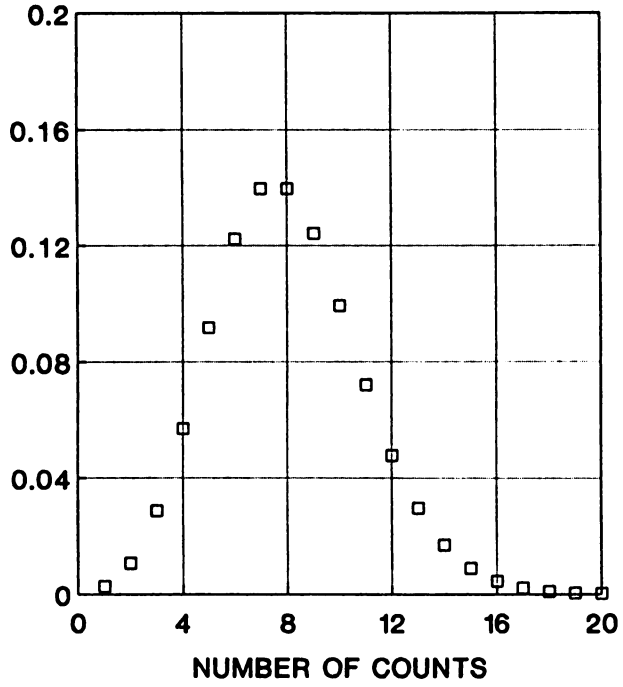

FIGURE 1
Poisson probability distribution for mean number of counts = 8.

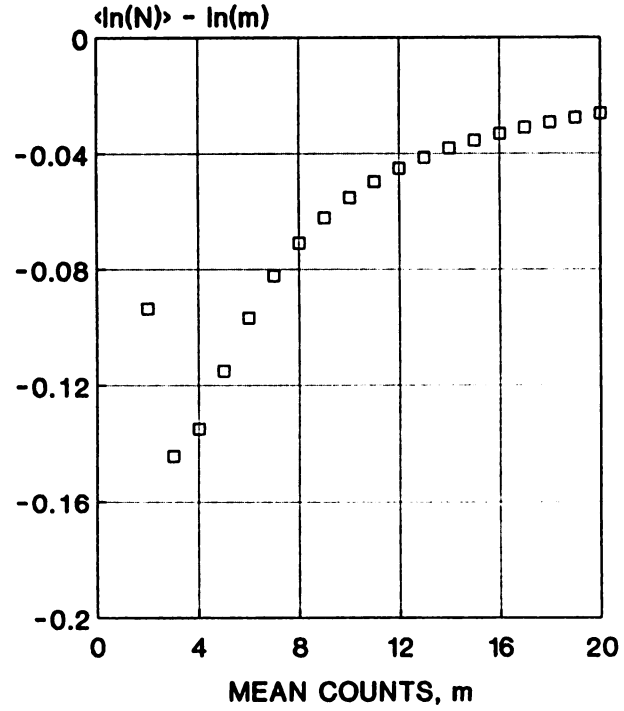

FIGURE 2
Difference between mean of logarithms vs. logarithm of mean for Poisson count distributions with different mean values, m.