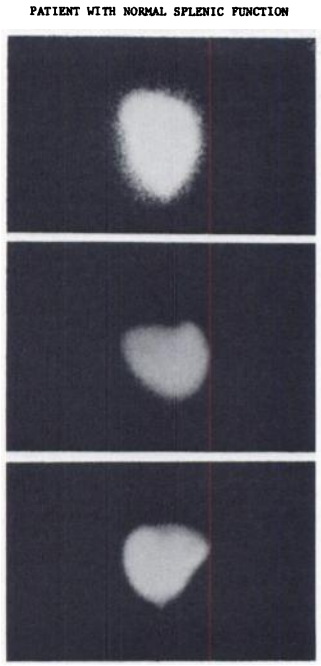

FIG. 1. Patient with normal splenic function. Top. LAO view purposely overexposed. Note virtual absence of pulmonary or hepatic uptake. Middle: left lateral view. Bottom: posterior view. Study shows typical heart-shaped "upside down" spleen, a normal variant.

us that they cannot provide this kit, nor are they aware of any plans to make it commercially available in the immediate future. In short, to get the BNL kits not only do we have to go through our own institutional bureaucracy (Human Investigation Committee, Isotope Committee, etc.), but also do the BNL paperwork (IND forms, patient report sheets, etc.). We have called our technique a "simplified" method because we can do it with reagents that are already approved for human use and are available commercially. Also the S^4 method allows the radiolabeling and the RBC heat-damaging in a single step. No centrifugation or RBC washing is necessary, and we thus find this much simpler than the nine-step BNL procedure.

In regard to the specific points raised by Drs. Som and Oster, we believe that Table 1 properly compares the temporal relationships of the two techniques. We have found step No. 4 particularly appealing for the S^4 technique.

Our experience with S^4 indicates that heating 35 min is *essential,* as demonstrated in Fig. 1 in our article. We could never make a 15-min incubation time work consistently in that we always saw residual blood-pool activity. Remember, we label and we heat-damage the cells in plasma, not in normal saline, which could explain the difference. Drs. Som and Oster question the quality of our images by pointing out that they show liver, lung, renal, and vascular uptake. They suggest this is due to the labeling procedure and show an elegant splenic image done with the BNL techniques to verify this claim.

First, we did not find cell fragments when S^4 RBC smears were examined with a light microscope after a 35-min incubation. Second, we think there is another explanation. We believe the reason for the radionuclide uptake in regions outside the spleen in Figs. 2 and 3 in our article is due principally to the poor splenic function in these patients. For comparison, we enclose a recent S^4 series from a patient with normal splenic function. Note that the LAO (purposely overexposed) shows no significant adjacent liver or lung activity. We let the reader decide whether or not he thinks our images are diagnostically useful.

Finally, we concur that the BNL kit consistently gives a higher labeled-RBC yield. We claim ~90% for our method, and recognize that the kit provides yields approaching 100%. In our experience, however, our selective splenic images are "selective enough" to provide the diagnostic information we need for clinical work.

The "efficacy" of a given test has occasionally been defined as the willingness of a laboratory to continue using a test once the person developing it has left the institution. In this case, even though Dr. Armas has finished his training and is using the method in New York, at Yale we still do about two S^4 studies each month when they are clinically indicated. We continue to find the technique diagnostically effective.

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Re: Clinical and Parametric Evaluation of Three Large-Field-of-View Cameras

While I recognize that the purpose of the referenced article was designed to show the relationship of physical performance to that of clinical performance, I believe the presentation can be misleading (*1*). Most readers will see it as a comparison of current large-field-of-view cameras, calling upon the information presented as a guide to the evaluation and selection of a scintillation camera system. The authors project this attitude by "rating" the camera performances in order of best to worst. If this were an intended purpose, it would only be fair to have tested current (late 1979) camera models for parametric against clinical correlation. During the period from 1976 to late 1979, significant improvements in camera uniformity, spatial resolution, linearity, and photographic displays have improved the quality of the clinical image as it relates to low-contrast detectability. Evaluation has shown that many late-model gamma cameras are not equal in low-contrast detectability. In their comparison of the mid-1976 and late-1977 gamma cameras, the authors have indeed presented the performance characteristics, but common to that vintage of gamma cameras only. Moreover, one must always question whether the systems tested were optimally tuned and meeting manufacturers' specifications.

To demonstrate performance specifications relative to camera vintage, we have performed some of the evaluation tests on our relatively new Picker gamma camera: a 4-15, 37 PMT, installed November 1978, equipped with the uniformity and energy-correction program (Micro Z Processor), and properly tuned. We offer the following findings to show the hazards of comparing gamma cameras that are not equipped the same (i.e., correction program, etc.) and not of the same production year. To simplify comparison, we have used the parametric evaluation chart offered by D. Chapman et al., and have included the specifications of our camera (Table 1).

As stated earlier, another important parameter in comparing camera performance is low-contrast detectability, a function most appropriate for imaging in the clinical environment (*2*). Our camera was evaluated by an independent group of consulting physicists in May of 1979 and in their report it was stated that the Picker 4-15 gamma camera installed at our institution exhibited the best low-contrast detectability at 10 cm yet measured by their group.

In conclusion, I am sure the nuclear medicine community is interested in the correlation of physical performance with clinical performance in the current state of instrumental art. I would also like to re-emphasize the importance of presenting parametric and clinical measurements that involve the determination of low-

TABLE 1. PARAMETRIC EVALUATION

Parameter	ON 410	Searle LFOV	Picker 4/15	Picker 15
Production year	2/77	9/77	6/76	11/78
Uniformity*	4.5%	7.9%	14%	5%†
Line spread function at surface of collimator:				
FWHM (mm)	5.2	6.6	6.8	5.8
Line spread function 2 in. of Plexiglas scatter: FWHM (mm)	8.0	9.2	9.8	8.2
Paralyzable deadtime 35,000 counts/sec	6.2	5.6	4.7	6.3
Counts/sec for 3 mCi Tc-99m	9.5K	11.5K	15K	12.8K

* Total percentage of pixels in the field that varied by more than ± 10% of the mean.

† 1978 Picker Camera with Micro-Z has an integral uniformity difference of ± 5% on any given area of the crystal and a differential uniformity of ± 2.5 compared with percentage of pixel deviations that were greater than a 10% spread in the other three cameras.

contrast detectability. After all, the advantages (if any) of improved system performance will not be in the delineation of high-contrast well-focused abnormalities, but rather in the early detection of low-contrast abnormalities. This fact is almost always overlooked in the parametric evaluation of gamma cameras. From the user standpoint, this represents the "proof of the pudding."

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REFERENCES

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2. ENOS GW: A phantom for clinical evaluation of total system resolution. *J Nucl Med Tech* 7:160-162, 1979

Reply

We agree with Dr. Lurus and Mr. Budzier on the importance of evaluating the state of the art equipment, the importance of low-contrast imaging performance, and the improvements made in imaging equipment during the period from 1976 to late 1979. However, in a rapidly changing field such as that of nuclear medicine, it is not uncommon in studies involving equipment performance to see major improvements in the equipment during the period between the initial gathering of performance data and final presentation or publication of the data.

We included the approximate manufacture date of each camera in our publication so that there would be no mistakes made by readers as to the vintage of the cameras. Also included in the text was the fact that the Ohio Nuclear camera was uniformity-corrected but the Picker was not.

It was not the point of our article to make an absolute comparison of just the parametric performance of these cameras. The point of the article was to show that for the "range" of parametric values established for these three cameras, we could see "no clinical differences" at the viewbox. We also stated that the parametric differences measured were, for the most part, no greater than those one may see in manufacturers' cameras of the same production run. Or, restated, if three cameras of the same manufacturer were measured, the parametric results could be different.

We did not quantitate performance of low-contrast detectability on the cameras. However, 11 of the 22 clinical studies subjectively evaluated were liver images, which do involve low-contrast detectability. All cameras performed equally well on clinical studies, as indicated by the viewers' ratings of 9.6 for Ohio Nuclear, 9.8 for Searle, and 9.7 for Picker, on a scale of 10.

The addition of your newer Picker camera to the parametric evaluation chart is of added interest. However, it falls within the range of values we previously measured and may or may not improve the evaluation of clinical images relative to the cameras tested.

Even now the camera you describe is not state of the art when compared with large field-of-view cameras using 1/4- to 3/8-in. detectors and 61-75 photomultiplier tubes. If these are added to the chart of parametric evaluations, further improvements would be demonstrated. If the new cameras shift the "range" of measured values by significant amounts, at some level of improvement clinical differences are sure to be seen. It would be interesting to repeat our work, adding low-contrast detectability, on the 1980-generation cameras. Unfortunately, we do not have the equipment to do so.

We re-emphasize that the purpose of our publication was to evaluate the clinical relevance of measured parameters. Over the ranges we measured, no significant differences were observed clinically.

We did not intend to imply that improvements in instrumentation, or measurements of these improvements, are not worthwhile. We believe that significant parametric improvements in instrumentation will result in improved clinical images.

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Re: A Comparison of Four Standard Scintigraphic TV Displays

I applaud Dr. Houston's contribution to the badly needed quantitative characterization of the performance of various display modalities in nuclear medicine. He usefully notes that different display devices and/or intensity representations may be best suited for different classes of images. As he says, this is because the two devices and/or representations may provide not only different overall sensitivities to intensity change in the recorded image but also different sensitivities to changes in different parts of the intensity scale.

I cannot agree with the attempt to compare, across a range of images, displays with different sensitivity curves. These displays are essentially not comparable, because simple contrast mappings (monotonic functions of recorded intensity applicable by listing in a table or by an amplifier) can reverse the result of the comparison for any image or class of images.

Rather, to allow comparison one must first normalize each device by preceding it with a contrast mapping that makes equal changes in intensity in the recorded image equally perceivable. (We have developed a straightforward method for determining such