compact bone that profoundly influences the CT results. Second, the trabecular bone of the limbs does not reflect changes in the axial skeleton; it has been characterized as metabolically inactive.

It might be difficult for readers to reconcile the latter point with Hosie's contention that there is a good correlation between trabecular bone density of the distal radius and that of the spine. In the first report cited by Hosie (*3*), the CT determinations in both locations were made on macerated specimens from normal subjects. Even with one highly deviant case excluded, the predictive error was 10–15%. In the second study (*5*) the predictive error appeared to be closer to 20%, or about the error one sees in predicting vertebral density from compact bone. In another study by Bydder et al. (*6*) the predictive error again was 15–20%. Moreover, there was a far lower correlation, with a considerably different (and lower) slope, in osteoporotics compared with normals. This closely parallels the findings in our report. Prospective studies have shown that several drugs used in osteoporosis positively influence the axial skeleton without concomitant effects on the distal radius.

Given the relatively high cost of specially constructed CT scanners, their technical problems, and the apparent differences between axial and appendicular trabecular bone, it would be prudent for interested investigators to await further reports from existing units using this exciting but unproven method.

RICHARD B. MAZESS
Medical Sciences Center
Madison, Wisconsin

REFERENCES

1. SCHLENKER RA: Percentages of cortical and trabecular bone mineral mass in the radius and ulna. *Am J Roentgenol* 126: 1309–1312, 1976
2. WAHNER HW, DUNN WL, RIGGS BL: Noninvasive bone mineral measurements. *Sem in Nucl Med* XIII(3):282–289, 1983
3. RÜEGSEGGER P, ANLIKER M, DAMBACHER M: Quantification of trabecular bone with low dose computer tomography. *J Comput Assist Tomogr* 5:384–390, 1981
4. RAO PS, ALFIDI RJ: The environmental density artifact: A beam-hardening effect in computed tomography. *Radiology* 141:223–227, 1981
5. HANGARTNER TN, OVERTON TR: Recent developments in peripheral CT measurements. *J Comput Assist Tomogr* 7:553, 1983
6. BYDDER GM, ELSASSER U, HESP R, et al: The relationship between CT measurements on the radius and results obtained by other techniques. *J Comput Assist Tomogr* 6:211–212, 1982

Re: Improved Intrinsic Resolution: Does it Make a Difference?

The recent paper by Hoffer et al. (*1*) suggests that an improvement in the intrinsic resolution of an Anger camera from <4.9 mm FWHM at 140 keV to <3.8 mm FWHM has no observable effect on lesion detection in liver or bone images. The authors use ROC analysis to compare observer performance. We have used ROC analysis in our department to compare hard-copy imaging formats (*2*). In an unpublished part of our study we compared analog (Polaroid) images from a Union Carbide Cleon 720 Anger camera (intrinsic resolution 5.3mm FWHM at 140 keV) and a Nuclear Enterprises Mark 4 (intrinsic resolution 7.1mm), each fitted with a high-resolution low-energy collimator. The images, each of 1 million counts, were formed by placing an absorber (20mm diam) between the Anger camera face and a flood source for different periods of time and at different sites to simulate photon-deficient lesions of varying contrast. Seven observers studied a set of 100 images from each camera, and ROC and LROC curves wer produced. Using the methods detailed in our paper (*2*), we derived from these curves two sets of seven areas for each camera. The areas were then compared using the Wilcoxon Matched Pairs Signed Ranks test. No significant difference was found in observer performance between the images from the two Anger cameras.

This study shows that improved intrinsic resolution from 7.1mm to 5.3mm FWHM did not significantly improve detectability for the size of photon-deficient lesion selected for investigation. Whereas metastatic lesions in the liver are likely to be of varying size and at varying depths, it has been observed at autopsy that superficial lesions are present in 90% of cases, and in 70% of cases the lesions are greater than 20mm in diameter (*3*). Thus for practical purposes, improvements in intrinsic resolution from 7mm to 5mm or so would not be expected to have a major effect on lesion detectability. The results of our simple study, however, lend support to the more detailed investigations of Hoffer et al. (*1*). The findings are also in keeping with an impression that recent advances in instrumentation and radiopharmaceuticals have not improved the diagnostic accuracy of conventional radionuclide liver imaging (*4*).

A. S. EADIE
T. E. HILDITCH
West of Scotland Health Boards Department of Clinical Physics and Bioengineering,
11 West Graham St
Glasgow G4 9LF.
U.K.

REFERENCES

1. HOFFER PB, NEUMANN R, QUARTARARO L, et al: Improved intrinsic resolution. Does it make a difference? Concise communication. *J Nucl Med* 25:230–236, 1984
2. EADIE AS, HILDITCH TE: A comparison of nuclear medicine imaging formats using ROC analysis. *Nucl Med Comm* 4: 296–301, 1983
3. OPPENHEIM BE, GOTTSHALK : Liver scanning. In *Diagnostic Nuclear Medicine*, Gottshalk A, Potchen EJ, eds. The Williams and Wilkins Company, Baltimore, 1979. Chapter 33.
4. ACKERY D: The Liver. In *Clinical Nuclear Medicine*, Maisey MN, Britton KE, Gilday DL, eds. London, Chapman and Hall, 1983. Chapter 10.

Reply

While the results obtained by Eadie and Hilditch are certainly compatible with our own, we do note that two different imaging instruments were used in their study. These instruments may have differed not only in intrinsic resolution, but also in energy resolution. Although both were equipped with "high-resolution" collimators, we have also observed marked differences in performance characteristics of collimators designated as "high-resolution" by various manufacturers. Moreover, and most importantly, the 20-mm test "lesion" used by Eadie and Hilditch would definitely militate against the observation of any difference in lesion detection between two systems with intrinsic resolutions of 7.1 and 5.3 mm FWHM.

Although we feel that the importance of improvement in intrinsic resolution has perhaps been overemphasized, it should not be disregarded. There is obviously some point at which degradation

in intrinsic spatial resolution does, in fact, interfere with lesion detection.

PAUL B. HOFFER
Yale Univ. School of Med.
New Haven, Connecticut

Analytical Performance of the ARIA II automatic system for TSH Assay

The widespread use of radioimmunological techniques in clinical practice has prompted numerous attempts to automate radioimmunoassay (RIA) partially or completely. The evaluation of the performances of these automatic systems has to be done not only in terms of practicability and throughput, but also and chiefly in terms of analytical reliability.

The fully automatic system ARIA II* has attained some popularity in laboratories, mainly for assaying T_3, T_4, and TSH. The performances of this system for T_3 and T_4 measurements have already been evaluated, either from results produced in a single laboratory (*1–3*) or from data gained in interlaboratory survey (*4*).

We report here estimates of the accuracy and precision of the TSH determinations carried out using ARIA II. This evaluation is based on data collected from a national external quality-control survey (EQCS) (*5,6*), which involved about 150 laboratories, nine of them being ARIA II users. The analysis was performed on the results of 51 EQCS samples sent in 11 monthly dispatches from December, 1981, to May, 1983; the majority of these samples (36) were unidentified replicates for the estimation of the between-laboratory, between-batch precision.

The precision was computed subdividing the results into two concentration ranges; the precision (CV) achieved by ARIA II users was 28.6% CV% (for samples with concentrations in the range 3–5 μIU/ml) and 17.2 CV% (range 5–20 μIU/ml). For comparison, the precisions of the other five most popular kits used in the survey, turned out as follows (respectively for the low and the high samples): Corning Immophase (7 labs) CV = 13.4 and 10.9 CV%, Cis-Sorin (9 labs) 18.1 and 12.6 CV%, Byk-Mallinckrodt (36 labs) 18.0 and 17.5 CV%, Biodata-Serono (27 labs) 28.7 and 20.6 CV%, Diagnostic Product Corp. (15 labs) CV = 34.7 and 18.7 CV%.

The accuracy of ARIA II was estimated with respect to the median (after rejection of outliers) of all results reported by participants in the survey. The results, shown in Fig. 1, indicate that ARIA II system consistently underestimates TSH concentrations. This negative bias was confirmed by the results of three recovery experiments (see Table 1) carried out by sending to the participants

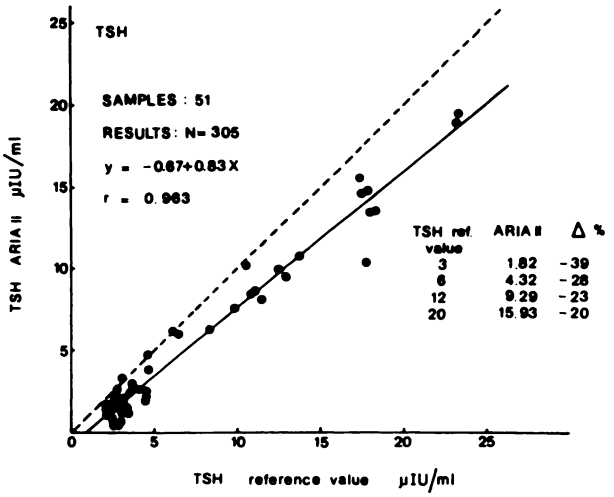

FIG. 1. Regression analysis of 305 results from laboratories using ARIA II system, against respective consensus medians taken as reference values. Closed circles represent mean values of ARIA II results found in each EQCS sample; regression and identity are shown as full and dashed lines respectively. Inset table reports mean readings by ARIA II users (computed from regression line) corresponding to four TSH levels, together with % deviations.

low-concentration samples spiked with known amounts of TSH standard (First IRP WHO 68/38 supplied by NIBSC, Holly Hill, Hampstead, London, UK).

We conclude that the TSH assays of the ARIA II system are not as good as those found for T_3 and T_4—in fact, ARIA II measurements of TSH are clearly inaccurate and, in addition, do not display better precision than that achieved by the nonautomated methods or kits.

G. C. ZUCCHELLI
A. PILO
M. R. CHIESA
M. A. PIRO
Istituto di Fisiologia Clinica C.N.R.
via Savi 8, 56100 Pisa, Italy

FOOTNOTE

* Becton-Dickinson Immunodiagnostics, 180 West 2950 South, Salt Lake City, UT 84115, USA.

TABLE 1. TSH RECOVERY OF ARIA II

Sample No.	Median of ARIA II results (μIU/ml)	TSH diff.	TSH 68/38 added	Recovery %
C092	18.90			
C090	1.70	17.20	22.5	76.4
C107	6.25			
C105	1.30	4.95	6.0	82.5
C112	13.45			
C109	2.70	10.75	15.0	71.7