the retrieval of learned material) but did relatively well on Similarities where the child is asked to respond to words that are provided (table 1 of the report).

Continued postoperative testing on the WISC added an additional sample of 33 boys and 20 girls. The trend held up in this later sample and figure 1 of the report shows the comparison of the Verbal IQ's of the boys and girls for the total of these two groups (93 boys and 78 girls). In order to see if the low Verbal IQ's of the girls was the effect of the surgery, we tested a third sample of 22 boys and 18 girls preoperatively on the WISC, and a similar trend was obtained. We reported for this group that the sex difference on Vocabulary was statistically significant but we should have added that in this sample, as in the two previous ones, the girls' lowest scores were on the Verbal subtests involving memory storage: Vocabulary, Comprehension, and Information. On the Similarities subtest, which is less dependent on memory, the girls' score was average according to the standardization sample and actually higher than the boys'. Additionally, the examiners were impressed that these girls appeared to grope for words and information that they could not bring to mind. Further indications that the deficit was specific were the findings that these girls performed normally on the Performance Scale of the WISC and did well on the Draw-A-Man test, earning higher scores on the average than the boys, which is the usual finding for this test. These results for children with heart disease requiring open-heart surgery may not prove definitive but they were highly consistent for (i) three subsamples, (ii) for all the examiners, (iii) for children of differing socio-economic status, and (iv) for the different cardiac diagnoses.

MARJORIE P. HONZIK
Institute of Human Development, University of California, Berkeley
DONNA S. COLLART
SAUL J. ROBINSON, KNOX H. FINLEY
Institute of Medical Sciences, Pacific Medical Center, San Francisco, California

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Occupancy Principle: Nonidentity with Mean Transit Time

Zierler (*1*) has asserted that tracer sojourn time (*2*), denoted occupancy (*3*), is identical to mean transit time (*4*). This assertion is true for an entire system (*5*). It is not generally true for a local region contained within a system, the situation considered by Bergner (*2*) and by Orr and Gillespie (*3*). An example where this distinction is of paramount importance is the radiation exposure of organs. The dose of radiation to an organ after a single injection of radioactive substance into the body is directly related to the sojourn time of the substance in the organ. The use of mean transit time in this connection can be very misleading. That the sojourn time can be many times greater than the mean transit time of a substance through an organ is shown as follows.

Consider a system in the steady state with a total input rate I(g/sec) of traced (mother) substance. Within the system is a region P containing the mass M_P(g) of traced substance and into which traced substance flows at total rate I_P(g/sec). Starting at time $t = 0$, a finite amount m_o (disintegrations per minute, dpm) of tracer is injected into the input channels of the system such that all portions of the traced substance are labeled in proportion to local input rate [equivalent tracer supply (*2*)]. At time t, the amount of tracer in the region P is $m_P(t)$ (dpm), the total rate of input of tracer into P is $i_P(t)$ (dpm/sec) and the total rate of output of tracer from P *is* $e_P(t)$ (dpm/sec). The tracer sojourn time for region P is defined as (*2*)

$$\theta_P = m_o^{-1} \int_0^{\infty} m_P(t)\,dt \qquad (1)$$

The mean transit time for region P is defined as the mean time of exit of tracer from P minus the mean time of entrance of tracer into P, or

$$\bar{t}_P = \left(\int_0^{\infty} t e_P\,dt \Big/ \int_0^{\infty} e_P\,dt \right) - \left(\int_0^{\infty} t i_P\,dt \Big/ \int_0^{\infty} i_P\,dt \right) \qquad (2)$$

It can be shown [appendix of (*6*) and reference (*7*)] that the relation between m_o and

$$\int_0^{\infty} i_P\,dt = \int_0^{\infty} e_P\,dt$$

yields

$$M_P = I\theta_P = I_P \bar{t}_P \qquad (3)$$

In general θ_P can be greater than, equal to, or less than $\bar{t}_P$. For example, let the region P be the human kidney and the system be the body. The total input rate I of water into the body is approximately 2.5 liter/day. The total input rate of water into one kidney, I_P, is approximately 0.7 liter/min or 1000 liter/day. For the human kidney, therefore, since $\bar{t}_P$ is approximately 20 seconds (*8*), θ_P is approximately 400 $\bar{t}_P$ or 2.2 hours. The reason θ_P is so much larger than $\bar{t}_P$ is that θ_P includes recirculation effects, but $\bar{t}_P$ does not. If the region P coincides with the entire system, then $I = I_P$, and Eq. 3 reduces to Zierler's relation (*5*). Equation 3 should prove generally useful, for example, to calculate sojourn times of substances in organs.

W. PERL
F. P. CHINARD*
Cardiorespiratory Research Laboratory and *New York University Research Service, Goldwater Memorial Hospital, Welfare Island, New York 10017*

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* Present address: Department of Medicine, New Jersey College of Medicine and Dentistry, Martland Hospital, Newark 07107.

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