expresses a contributon balance condition, just as the neutron transport equation expresses a neutron balance. In no way does it imply that contribution transport is not influenced by the material medium, since, as Gerstl points out, the contribution source is a function of the forward and adjoint fluxes.

The fact that the contributon conservation equation is not sufficient to solve for contributon density is not surprising. Considering a fluid flow analogy, it has been shown that Eq. (24) can be written in the same form as the mass continuity equation for compressible flow,[3] and that the equation is not sufficient to specify mass distribution. The energy and momentum equations must be considered as well.

Gerstl's statement that his Eq. (A) is the "true" contributon transport equation appeared to this reader to be rather bold. The fact that his mathematical manipulation (albeit very interesting) yields an equation for the product $\phi\phi^*$ does not necessarily mean that it is a transport equation, which implies certain physical characteristics. This reader could not determine the physical significance of a term such as

$$\left[\frac{\partial^2}{\partial x^2}(\phi\phi^*)\right]^2 ,$$

or how such a term pertains to transport phenomena.

Furthermore, Eq. (A) was derived only for the simplified case of monoenergetic neutrons in a purely absorbing medium, for which the forward and adjoint Boltzmann equations have analytic solutions. Therefore, the value for the contributon flux in this case can be computed on the back of an envelope, and there is little motivation for solving the second-order nonlinear equation developed by Gerstl.

M. L. Williams

Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee 37830

June 27, 1977

[3] M. L. WILLIAMS and W. W. ENGLE, Jr., "Spatial Channel Theory—A Technique for Determining the Directional Flow of Radiation Through Reactor Systems," *Fifth Int. Conf. Reactor Shielding*, Knoxville, Tennessee, April 18-22, 1977.

Optimized Taylor Parameters for Concrete Buildup Factor Data

Shure and Wallace[1] have provided very useful values of the parameters in Taylor's formula for gamma-ray buildup factors,

$$B_c = A\exp(-\alpha_1\mu r) + (1 - A)\exp(-\alpha_2\mu r) , \qquad (1)$$

based on data recently generated by Eisenhauer and Simmons.[2] However, the values given in Ref. 1 do not provide the "best" fit in the sense of minimizing the maximum percent deviation quoted in the tables.[3]

To show that better values, in the Tchebycheff sense, can be obtained, we have calculated values for a representative set of photon energies from 0.04 to 15.0 MeV, on the basis of a point source of monoenergetic photons in an infinite medium of ordinary concrete and on the assumption of an exposure (called "dose" in Ref. 1) detector.[4] The same data of Eisenhauer and Simmons as were fitted for Ref. 1 were used here. The results are given in Table I.

It can be seen from the comparison in the table that the values of the parameters shown here appear to provide a somewhat better fit than those in Ref. 1. Presumably, the other tabulated data in that reference could likewise be improved.

One minor point needs explanation and comment. The fitting accomplished by us ignored the data at 0.5 mfp. In our judgment, this was a wise thing to do because such values are not reliable:

1. It is known that the moments method is less reliable at distances near a point source. See Table X of Ref. 2, for example.

2. At small values of penetration, the Eisenhauer-Simmons code is known to give, under certain circumstances, results that are so obviously spurious they have to be replaced by interpolated values.[5]

[1] K. SHURE and O. J. WALLACE, *Nucl. Sci. Eng.*, **62**, 736 (1977).
[2] C. M. EISENHAUER and G. L. SIMMONS, *Nucl. Sci. Eng.*, **56**, 263 (1975).
[3] A. R. VETTER and A. B. CHILTON, *Nucl. Technol.*, **11**, 268 (1971).
[4] The computations were carried out by T. A. Keys, with the use of the University of Illinois IBM 360/75 computer. The results were kindly checked by K. Shure.
[5] C. M. EISENHAUER, Personal Communication (1977).

TABLE I

Taylor Parameters for Exposure Buildup Factor Data, Point Source in Infinite Concrete Medium (mfp range 0 to 40)

Source Energy (MeV)	Parameters for Eq. (1)			Maximum Percent Deviation (This Letter)	Corresponding Maximum Deviation (Ref. 1) (%)
	A	α_1	α_2		
0.04	2.33	-0.0147	0.317	4.5	6.14
0.06	5.29	-0.0414	0.210	5.3	7.32
0.08	18.3	-0.0382	0.0469	4.7	4.91
0.10	73.8	-0.0394	-0.0145	6.0	9.64
0.20	144	-0.0741	-0.0598	20.2	37.22
0.50	62.0	-0.0688	-0.0424	22.2	41.28
1.00	97.0	-0.0396	-0.0271	15.2	25.12
2.00	38.7	-0.0250	-0.00227	7.0	8.47
5.00	10.42	-0.0244	0.0269	1.5	2.14
10.00	5.10	-0.0269	0.0450	2.3	3.41
15.00	4.04	-0.0267	0.0393	2.7	3.55

If the buildup factor values at 0.5 mfp from Ref. 2 were included in our fitting, the parameter values results would be slightly different for source photon energies of 0.04, 0.06, 10, and 15 MeV. The other values would remain the same. Also, it is easily determined that the predicted values (B_c) using our tabulated values always give deviations at 0.5 mfp less than the maximum deviations quoted in Ref. 1 except for source energies of 0.04 and 0.06 MeV, for which the deviations are slightly larger.

A. B. Chilton

University of Illinois
Nuclear Engineering Program
Urbana, Illinois 61801

June 13, 1977

Comment on "Optimized Taylor Parameters for Concrete Buildup Factor Data"

Chilton[1] comments that the values of the parameters in Taylor's formula that Shure and Wallace[2] derive for gamma-ray buildup factor data for concrete[3] does not provide the "best" fit in the sense of minimizing percent deviation. Chilton demonstrates that better parameters in this sense can be obtained. The ranges of deviation of calculated buildup factors, B_c, from the original data, B, for both sets of parameters for the gamma-ray source energies, E, of Ref. 1 are given in Table I. The criterion used by Chilton should, and as seen in Table I does, provide maximum positive and negative deviations of about the same magnitude for a given energy.

The criteria used and previously identified by Shure and Wallace[2] are two-fold: The set of parameters obtained should be such that the percent deviation $|(B_c - B)/B|$ is less than ~5% (without attempting to minimize the magnitude below 5%), and, if this cannot be achieved, the percent deviation is minimized subject to the constraint that B_c/B is greater than ~0.95. With this constraint, in ultimate application, calculated air kerma or dose[3] or exposure[1] rates will not be underestimated by more than ~5%. As seen in Table I, the first part of the criteria is met except for $0.1 \leq E \leq 2.0$ MeV, and in this energy range the second part of the criteria is met.

TABLE I

Range of Deviation of Calculated Exposure Buildup Factors from Original Data, Point Source in Infinite Concrete Medium

(mfp range 0 to 40)

Source Energy (MeV)	Range of Deviation (%)	
	Chilton (Ref. 1)	Shure and Wallace (Ref. 2)
0.04	+4.45 to -4.47	+6.14 to -5.11
0.06	+5.29 to -5.30	+5.76 to -7.32
0.08	+4.67 to -4.74	+4.40 to -4.91
0.10	+6.02 to -5.94	+9.64 to -5.03
0.20	+20.23 to -20.24	+37.22 to -6.10
0.5	+22.22 to -22.24	+41.28 to -5.66
1.00	+15.24 to -15.22	+25.12 to -4.90
2.00	+7.01 to -6.98	+8.47 to -5.02
5.00	+1.48 to -1.48	+2.14 to -0.91
10.00	+2.27 to -2.26	+0.11 to -3.41
15.00	+2.66 to -2.66	+1.32 to -3.55

Note that for a given source energy, the total width of range of deviations in Table I appears to be reasonably insensitive to the criteria used in deriving the parameters.

Whether Chilton's parameters are "better" values than those of Shure and Wallace is a decision that the user of such parameters must make for his particular application.

K. Shure
O. J. Wallace

Westinghouse Electric Corporation
Bettis Atomic Power Laboratory
P. O. Box 79
West Mifflin, Pennsylvania 15122

July 5, 1977

ACKNOWLEDGMENT

Bettis Atomic Power Laboratory is operated for the U.S. Energy Research and Development Administration by Westinghouse Electric Corporation.

[1]A. B. CHILTON, *Nucl. Sci. Eng.*, **64**, 799 (1977).
[2]K. SHURE and O. J. WALLACE, *Nucl. Sci. Eng.*, **62**, 736 (1977).
[3]C. M. EISENHAUER and G. L. SIMMONS, *Nucl. Sci. Eng.*, **56**, 263 (1975).