SCOPE AND OBJECTIVE

Solutions of the various problems in the theory of photon or particle transport generally involve solution of various types of integrodifferential equations simple or complex, depending on the nature of the problems. Exact and complete solutions of all the problems cannot be expected to be feasible from the practical point of view. There are various approximate methods and some exact methods developed for the solutions of these transport equations. We have made a survey of these methods in the general introduction.

There are several exact methods which have been successfully applied to the solutions of one-group transport equations in infinite and semi-infinite media scattering isotropically or scattering with moderate anisotropy, and also to two-group transport theory in such media, of course, involving considerable labour. However, till 1962 exact method of solving transport equations in <u>finite media</u> could not be fully developed, although Chandrasekhar (1950) attempted to furnish such a method by using the Principle of Invariance, in the conservative case. Busbridge (1960) went a step further in this respect by using the Ambartsumian technique in combination with the theory of Neumann solution. For the non-conservative Case no answer to the uniqueness of the solution could be provided by Chandrasekhar and Busbridge. The answer has been provided by Mullikin (1962, 1964) who applied Muskhelishvili's theory of singular integral equations (Muskhelishvili, 1953, Chap. 14; Busbridge, 1955) to obtain Fredholm integral equations for certain functions the calculations of which from these Fredholm equations gave a unique determination of the solutions of finite media problems.

The method of eigen function expansion as developed by Case (1960) has been applied to the exact solution of transport equations in infinite or semi-infinite media scattering isotropically or scattering with linear anisotropy (Case and Zweifel, 1967). In applying the Case's eigen function method to the solution of transport problems in a multiplying finite slab (and to the consideration of the criticality problem) the angular density is expanded in terms of the discrete and continuum eigen functions. The coefficients of expansion are determined by applying the boundary conditions and the orthogonality relations and some identities. But the coefficients of the continuum eigen functions are given by an integral equation (whose exact solutions are not known) which can be converted to an integral equation of the Fredholm type admitting of an iterative solution.

In the present work our objective is to show that the Wiener-Hopf Technique is as powerful as (perhaps more powerful than) the existing other methods for finding exact solutions of transport problems. Wiener-Hopf Technique has been applied to find the exact solutions of transport problems in semi-infinite media scattering isotropically or with moderate anisotropy (Placzek and Seidel 1947; Marshak, 1947;, Shu-SuHuang, 1955; Das Gupta, 1956, 1957, 1958, 1965, Boffi, 1970); but its application to transport problems in finite media or to complex problems in semi-infinite media to find exact solutions in tractable forms, was found distinctly possible after Das Gupta (1974, 1977, 1978), had published his three papers on H-functions of transport problems (in passive and multiplying media) in which there had been given new representations of H-functions and new decompositions of H-functions $R(z)$ and $S(z)$, where $R(z)$ is a rational function displaying the poles of $H(z)$, and $S(z)$ regular on $[-1,0]^c$, displays the branch points of $H(z)$ at -1, 0, it being stressed that another decomposition of the product of two functions (complex) into the sum of two functions $R^+(z)$, regular on $[0,1]^c$, and $R^-(z)$ regular on $[-1,0]^c$, is an inseparable part of the methodology of the application of the Wiener-Hopf Technique to the exact solutions of transport Equations in finite media or of the complex transport equations in semi-infinite media (Das Gupta, 1978b, Appendix); (cf. Das Gupta and Das Gupta, 1987).

The first application of Wiener-Hopf Technique to the exact solution of complex transport equation in semi-infinite media (such as transfer equation for interlocked multiplets in Stellar atmosphere), and to the exact solution of transfer equation with moderate anisotropy in finite media, has been made by Das Gupta, (1978a, 1978b) (see Das Gupta et al, 1980).

Wiener-Hopf Technique had been further applied to the exact solutions of four other transport problems in finite passive and multiplying media (Das Gupta and Bishnu, 1981; Bishnu and Das Gupta, 1987; Bishnu and Das Gupta, 1991; Bishnu and Das Gupta, 1992 which now form the material content of the thesis.