WHAT I LEARNED FROM PROFESSOR BRIAN SPALDING

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ABSTRACT

I worked with Prof. Brian Spalding from September 1977 to July, 1983. When I joined Imperial College in September 1977, Prof. Spalding (his students affectionately called DBS) was trying to extend his famous GENMIX computer program to compressible flows with shocks. GENMIX is a general-purpose computer program developed to solve two dimensional, boundary layer flows for incompressible or subsonic flows with low Mach numbers. In order to solve high-speed compressible flow in a boundary layer, DBS correctly figured out that he had to let the pressure field to vary inside the boundary layer (for incompressible flows, free stream pressure is impressed inside the boundary layer, thus pressure does not vary in the direction normal to the stream lines). He came up with an algorithm to correct the vertical pressure field (normal to the marching direction) downstream if the flow is supersonic and upstream if the flow is subsonic. The algorithm worked very well if the flow is fully supersonic or if it is fully subsonic. However, the algorithm failed if the flow goes from supersonic to subsonic through a shock. DBS maintained that we made some programming error and there was nothing wrong with the algorithm. It took me two semesters and lot of writing back and forth with DBS that I finally convinced him that the algorithm is flawed because it created more equations than the unknown pressures. I demonstrated this by solving the transonic flow through a 1D, divergent duct but it cost me additional 5 years to finish my doctoral degree!! My struggles with the compressible flow algorithm made me resilient and prepared me for an academic career. I owe this to Professor Brian Spalding.