INTRODUCTORY REMARKS

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As president of the organizing committee of this meeting I was granted the honor of opening the conference. But despite appearances I was only a figurehead that Jean-Paul Zahn somehow decided to set up. Whatever his motivation was, his execution was excellent and my first remark must be an expression of my admiration for the marvelous job that he and his associates have done in providing all the spiritual, intellectual, and material advantages that we found waiting for us in Nice. Let me assure you though, that a token president is not without uses and I wish I had known this before accepting the job. I spent the days before and during the conference running routine errands, carrying luggage, and being reprimanded for some of the minor things that inevitably must go wrong in many large gatherings. I was even scolded because the name of some-one who had not said he was coming was omitted from the list of participants. And when the time was running short during the meeting, I was obliged, in a statesmanlike gesture, to cut my scheduled one-hour talk to eight minutes. But rank has its privileges and mine was to be informed of the guiding principles behind the organization of the conference. Permit me now to share these with you.

It happened that the first day of the conference coincided with that of a large political convention (in another place,happily), and that suggested a convenient metaphor for describing the divergence of viewpoints among the participants. Let us therefore discuss the politics of stellar convection theory.

At the extreme right of the convective political spectrum are those who want to write down the full equations and solve them. The ultra-conservatives, as I shall call them, have virtue but no results that apply directly to stars.

At the other extreme of the convection spectrum are the radicals who want to write down an algorithm for computing stellar structure that contains adjustable parameters which can be fit to well known cases. In an extreme version of this we would write : $R = R_*$ where R is the radius and R_* is an adjustable parameter. If we fit the parameter to the sun we get $R_* = 7 \times 10^{11}$ cm and the resulting formula turns out to describe a large number of stars tolerably well. I think it is fair to say that no one at the conference was this radical, but it would be hard to deny that there have been things in the literature that have these overtones.

But let me come to the political views represented by the actual participants. I cannot be too specific since many participants have sometimes yielded to expediency and shifted ground shamelessly. Nigel Weiss is a case in point. This paragon of the right

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has recently (with Gough) written a paper on stellar mixing-length theory in what must be the greatest fall from grace in recent memory. Having viewed this behaviour with alarm let me point with pride to the spectrum of opinion represented here.(The infrared has been filtered out.)

In these proceedings we have a coverage of this spectrum from mixing-length theory to computations on the full equations (for limited parameter ranges). Naturally, this represents more than most astrophysicists need to know about convection. Some will merely read this introduction, expecting to find out where the best current approach is described, hoping that this will be consistent with the constraint that results are to be found in a finite time ---------- say months. I have,of course, anticipated this need, but am not sure I can meet it.

Douglas Gough and I spent the summer in a Cambridge drought trying to prepare a statement that will answer such a specific question. Naturally, I didn't have time to give the results of our lucubrations in my spoken introductory remarks. Nor did Gough manage to fit them into his lecture on standard mixing-length theory. That does not mean that we could not put it all into one of our manuscripts. But which paper should it be in? The solution is that we have prepared a joint appendix which I am told will appear somewhere below.

Our conclusion is that a non-local mixing-length theory seems to be the best that one can do at present. Unfortunately, this is not a precise statement and we simply give an outline of how such an approach might be made and try to give an indication of the physical assumptions needed. There are other ways to go about this, and our aim is merely to suggest the level of sophistication in mixing-length theory that we think may be warranted in stellar models.

I have indicated the spread in the approaches to convection discussed below as a kind of abscissa. There is also an ordinate which represents a spectrum of complications that arise in convection theory in specific kinds of stars on stages of evolution, or refer to effects that are usually presented but ignored in first approximation. If we must look mostly to the left to get usable results for stellar structure theory, it is equally true that we usually turn to the right for guidance about how to handle these special effects. For even if the solutions of the conservatives are not directly usable for stars, they can be extended to include compressibility, rotation, magnetic fields, compositional inhomogeneities, penetration, and, if we would just take the trouble, coupling to pulsation. The hope is that what a special effect does to a conservative's solution it will probably do to a radical's model. This half-truth in practical terms means that by seeing what rotation does to Boussinesq convection in two-dimensional or modal convection, you may build enough intuition to make a cogent argument about what it does to stellar convection. For example, when stellar model-builders want to decide what to do about semiconvection, let them read Huppert's article on thermohaline convection. No doubt many astrophysicists will not care for this general viewpoint unless it happens to lead to answers according with what they need to coax their models into agreement with observations. Eric Graham's discussion is a good case in point.

Graham has numerical solutions for fully compressible three-dimensional convection in a layer several pressure (and density) scale heights thick. Apart from a charming tendency to swirl about, his flows look startlingly like Boussinesq convection, and he detects no sign of scale heights influencing his dynamics. Radicals will probably ignore this result. What else can they do?

Lest I seem to give too much credit to the conservatives let me point out their main fault : they rarely include effects in their calculations that are motivated by purely astrophysical convection problems, but rather study traditional effects. If they want to prove me wrong about this let one or more of them do a proper Boussinesq calculation of the URCA convection problem summarized here by Giora Shaviv. This example does not have the double entendre of something like rotation that interests meteorologists also. So much for the ordinate.

In these proceedings we shall also leave the phase I have been describing to have a look at recent trends in turbulence theory. Those who have followed this subject at all know that it too has something of a political spectrum and some of the extreme conservatives of turbulence report here on current approaches. Uriel Frisch will translate the right wing's latest credo, fractal dimensions, into terms the leftist can understand, and Yves Pomeau will tell us about aperiodic oscillations. These both refer to forms of mathematics that may help us to see what turbulence is. Pomeau's talk is concerned with systems of o.d.e.'s that give periodic solutions except in certain parameter ranges where they go into aperiodic, almost random behaviour. The suspicion has been around for many years that this behaviour may have the mathematical ingredients that give turbulence its stochastic features and, lately, attempts to formulate this idea precisely have been mounted. But even if this does not turn out to work, it does not hurt to know about aperiodic oscillators in other contexts. The funny behaviour of the solar cycle during the reign of Louis XIV may have been a manifestation of such an aperiodic oscillator of interest to this audience.

This has been a lengthy introduction yet it has not told you the full range of topics to be covered. I hope that it gives you a flavour of what to expect in looking over the proceedings. I am told that all the contributed papers have been refereed and so the prolixity stops here. There is not even a concluding oration to be reported. Of course, I happen to have a manuscript called "Convection in Stars III..." that might have served, but that is destined for other things. However, a brief summary of developments before this meeting is in Gough's report for IAU Commission Mestel and it is reprinted here with bibliography. Its adequacy as a summary may be a measure either of the rate of progress in this subject or of Gough's perspicacity.