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General Discussion (Origin of the Solar System)

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General discussion (Origin of the Solar System)

T. Gold, F.R.S. (*Center for Radiophysics and Space Research, Cornell University, Ithaca, New York* 14853, *U.S.A.*). There are several indications that cause one to consider some cataclysmic event having occurred in the early Solar System. First, there is the fact that the Sun is 7° skew to the planetary disc, and this is too large an angle to be accounted for, if the angular momentum of Sun and disc came from a common system. It is too small an angle, though, to attribute Sun and disc to entirely different sources. Some major perturbation has to be invoked, while the gaseous disc was present, and before it had formed the planets. A later perturbation would give different inclinations to the different planets.

Secondly, there is the matter of the missing hydrogen and helium from the domain of Uranus and Neptune. The only sequence of events that one can infer is: that the light element ices condensed out of the general gaseous disc there, just as in the region of Jupiter and Saturn; that cores of Jupiter and Saturn formed from the collection of the ice-grains, and grew sufficiently massive to hold in hydrogen and helium, and thereby grew to their present masses; but that Uranus and Neptune no longer had the hydrogen and helium available in their domain when they had formed. Otherwise they would equally have acquired gigantic light envelopes. Between the time that ice-grains condensed and Uranus and Neptune had formed, the remaining gas must have been removed from the region. A large amount of energy is required for this and again this suggests some kind of cataclysmic event. It could have been a violent solar event, or a nearby stellar explosion. It cannot have been the gravitational interference of a nearby star, for this would have upset the coplanar orbits of the planets.

Lastly one may also consider the relation to the solar neutrino problem. The low neutrino count observed would be accounted for if the inner regions of the Sun were of low metal content, and only a subsequent addition had supplied the present high-metal material and contaminated only the convective layer. I have no detailed suggestion for this process, but I believe that one should keep this in mind when discussing any outside interference to the early Solar System.

T. Kirsten (*Max-Planck-Institut für Kernphysik, Heidelberg, F.R.G.*). In connection with Professor Gold's remark concerning the low Z model of the Sun to account for the high energy solar neutrino deficit, I should like to make two comments. First, like all non-standard solar models, the low Z model, which implies heterogeneous accretion, is an *ad hoc* model. Observationally, one can object to it on the grounds that for smaller, more convective stars or for the more evolved convective red giants Z would have to be lower because of dilution with the supposedly low Z interior. This is not observed.

Secondly, I want to mention that the Gallium Solar Neutrino Experiment, which is under way in an international collaboration, is aimed at measuring the low energy pp-solar neutrino flux which is much less dependent on temperature and opacity than the ^{8}B-flux measured in the Chlorine Experiment. This will decide whether the neutrino deficit has astrophysical reasons at all or whether the cause for the neutrino deficit is related to neutrino properties.