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Scientific research careers: Holding patterns

One of most disconcerting features of a scientific career (in India and elsewhere) is that very highly qualified personnel can remain 'unemployed' for short to long periods at crucial stages of their career while they are making the transition from an earned doctoral degree to a permanent job or from foreign training or assignment to one at home. This could be one more reason why the younger generation does not take so kindly to a career in science when so many softer and more lucrative options (writing software; selling soaps, derivatives, or whatever) materialize in a globalized, liberalized economy.

The Human Resource Development Group at CSIR sits on a wealth of data related to the HRD scenario in S&T in the country. In this issue (**page 578**) we have a profile of Senior Research Associates (SRAs) who are kept in "Holding patterns" in a "Scientists' Pool" (the aeronautical and nautical metaphors don't seem to mix well!) until they are permanently settled. Over a forty-year period, offers were made by the CSIR to nearly 20,000 aspirants and over 10,000 accepted the Associateship. The present study is confined to nearly 900 SRAs who left the scheme during 1991–95 after serving full (three years) or partial tenures.

That the average age of SRAs at the time of joining the pool ranged from 32 to 35 years across disciplines is most demoralizing as these are young men and women at the height of their powers. Nearly a third stay for a full term of 36 months. If the purpose of the scheme is to nurture and develop genius and talent, stipends and conditions should be made much more handsome and not paltry and demeaning as they often are. The promise of '... utilizing [one's] full potential ... while searching for a job' seems to be an obvious contradiction in terms.

Clever as we scientists are, we have still not found a simpler way to absorb highly qualified people without such a waste of precious time and nervous energy. It is impossible to imagine MBAs fresh out of Business School being held in limbo like this by the corporate sector. The only profession where long internship is the norm is the medical profession and the present survey confirms this – more than half (493 out of the 899 sampled) were placed in medical colleges and hospitals. Unfortunately, the psychological trauma that can accompany such extended tenures is rarely captured in 'beam-counting' statistical surveys such as this; perhaps the HRDG will in future look at the larger sociological and psychological undercurrents of such schemes. That such schemes exist shows our failure to evolve strategic procedures where freshly trained R&D scientists can go directly from school to professional laboratory bench.

There is no doubt that the SRA scheme is a safety net cushioning highly qualified personnel from actual unemployment in periods of career change. The CSIR scheme is particularly generous and foresighted in the flexibility it offers. There is evidence to indicate that many associates have in fact gone on to distinguished careers. Sadly, systematic tracking of the career paths of SRAs after their internship is poor – records are available for less than half of the Associates. An equally valuable exercise may be to track the half of applicants who have declined the offer to know for sure what greener pastures beckon them. A more complete record would be very valuable.

G. Prathap

Visualization of cloud-like flows

When one watches, in awe, a rapidly changing mass of cumulonimbus cloud, one does not need much technical knowledge to conclude that it must be a very complicated object involving difficult physics. The boundaries are not well defined and change with time and the cloud is clearly not made of a single constituent alone. In fact, clouds are, in general, dynamically changing mixtures of air, water, water vapour and ice. As a consequence, both dynamics and thermodynamics play important roles in cloud physics. To start with, the cloud medium is in constant motion internally with complicated secondary motions superposed on the normally present updrafts. Since clouds can be so large, the length scales are too and so the effective Reynolds numbers, which give us some idea of the relative importance of inertial forces to viscous forces, are enormous. Under such circumstances, turbulence is the norm and is in a Reynolds number range which is very difficult to simulate in the laboratory. It is sobering to note that in such flow fields the largest scales can be of the order of kilometers while the smallest (dissipative scales) are of the order of millimeters or less.

If clouds can contain water in their three phases, a natural question then is, how might phase change affect the cloud phenomenon? One might naively hope that the latent heat release, which for water is very large, might significantly affect the thermodynamics alone, i.e. principally affect the temperature distribution alone without greatly changing the flow field. To get some idea of what is involved, consider a small parcel of moist air rising inside the cloud on account of buoyancy. As it rises it cools but if the water vapour gets saturated, condensation may occur;

the resultant heat release can warm the air, further aiding the buoyancy of the parcel of air and helping it to rise further. This is but one possible scenario. In their article Venkatakrishnan *et al.* (page 597) show that things can be very complicated and that in fact heat release can considerably change the dynamics of the turbulent flow field.

Venkatakrishnan *et al.* report on a series of flow visualization studies conducted on turbulent jets and plumes (which are more cloud-like) in water. Volumetric heating is injected to simulate the effect of heat release in clouds. By using a laser sheet and a fluorescent dye it is possible to obtain visualizations of instantaneous axial and normal sections of the fields with and without heating so that the effects of heat addition on the fields, if any, can be seen. The technique permits one not only to estimate the growth of the jet/plume with distance but also to clearly visualize sections of the vortical structures that make up the organized structures in these turbulent flows. In particular, this permits one to examine the highly contorted surfaces separating the jet/plume fluid from the ambient fluid, regions crucial to the mixing process.

The authors of this study find that both in the plume and the jet, the structure and dynamics are altered considerably by volumetric heating. Not only is the spread of the plume arrested but there is considerable disruption of the large eddies in the field. Thus, volumetric heating, more than merely enhancing the buoyancy of the plume or jet, significantly affects the whole entrainment process. This conclusion has an important bearing on, among other things, the question of the effect of phase change on the dynamics of clouds.

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