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Session 1: Dr H. Corte

IN MY introduction to session 1, I made the point that most of the material presented in this session could be seen almost as a continuation of the corresponding part of the Oxford symposium in 1961. This continuity, which was very noticeable in other sessions also, is one of the assets and attractions of these symposia. There are people (and I have met several) who think that such a continuity signifies lack of ideas, a state of stagnation. They argue that we must be 'with it', that there must be something new, even topical, every time. I do not agree with this at all. On the contrary, if we let ourselves be dominated by the notion that there must be a frantic search for a new 'in' subject every time we plan a symposium, we are in danger of becoming organisers of yet another set of technical gatherings, useful, most likely, but not necessarily bearing the stamp of fundamental research.

The simple fact is that in every industry, including the paper and board industry, the number of central fundamental areas of research is limited. This number is growing, certainly. New branches of science, hardly noticed before, suddenly become the centre of attraction as the industry moves into new fields or adopts new methods. Yet such a growth is usually slow.

An additional fact is that papermaking (as we all know) is not a science-based industry. Consequently, its scientific foundations are less well recognised than, for example, in the chemical or electrical industries. They are there nevertheless and fundamental research in our industry is mainly concerned with their exploration and, indeed, discovery. We still do not know exactly what holds a sheet of paper together and precisely why certain measures at our disposal influence certain properties in certain ways. In other words, we have still a lot of digging to do before the roots of our industry are in full view. Our direction is therefore one of depth. We will keep discussing porosity, mechanical strength, etc. from varying angles of course, but hopefully a little deeper every time. This is why the continuity of our symposia is not only appropriate and attractive, but vital.

The main subject of session 1 was the structure of paper. One might argue—What has this got to do with usage properties? Well, it took twelve years to impress on most people the fact that the uneven areal mass distribution is perhaps the most characteristic single difference between paper and other sheet or foil-like materials. This is not to say that the non-uniformity was not

recognised before. It certainly was, but the implications for virtually all usage properties were not. I have a feeling that they still are not clearly enough appreciated by many.

Prof. Wahren and Dr Norman are engaged in some pioneering work here. Thanks to their efforts and to those of other workers including myself, people will eventually realise that the distribution of fibres and flocs in a sheet of paper does affect its printability, its usefulness as a filter medium or as a coating base, its runnability on all kinds of converting machines and so forth. One day, we may even be able to assign a money value to the variance of the distribution of the mass density (DMD) in a given case of application. For example, if a paper is to be coated with an expensive coating colour, a reduction of the variance of DMD by x per cent will save y g/m^2 coating weight or £z per annum.

It will for some considerable time remain a worthwhile research subject to explore the connection between the mass distribution and usage behaviour, but we must always remain critical of the methods we employ to determine the mass distribution and of how we interpret the results.

This applies in particular when we compare DMD not with the bulk behaviour of the sheet, but with properties that have themselves a small-scale areal distribution. I am speaking of Lyne & Hazell's article. The laser holographic interferometry method is probably coming, particularly the double beam variation. In a few years' time, most self-respecting research establishments will have it, but to compare the results obtained with this method with those of optical formation meters takes some swallowing. This is where concepts are in need of precision and problems in need of accurate definition. What surprised me was that Dr Dodson's work on relating local areal dilatations to the grammages in the same localities went completely unnoticed, although the results of this work were expressed in quantitative probabilistic terms, not just in the form of correlation coefficients. It is not unusual that some interesting and relevant work is done, published, forgotten and redone by somebody else. It has happened to me. The literature survey usually conducted at the beginning of a major project should remain a continual effort as the work progresses and include literature from countries and in languages that are not the author's. This criticism is not levelled at Lyne & Hazell's contribution, but is meant for general consumption.

Fracture is obviously related to the local variable extension of paper, hence its DMD and we heard of some unexpected behaviour of newsprint from Moffatt and his co-workers. Whatever the mechanism, breaks on converting machines (whether continuous printing or coating or bag-making) mean visible loss. This is why the commercial importance of DMD may perhaps dawn upon this group of converters and their suppliers before people like

filter manufacturers or sheet printers wake up to it. The subject 'small-scale mass distribution' will now stay with us for some time to come.

The other structural feature of paper is that it is layered; again, a feature that has taken about twelve years to become recognised as a fact of papermaking life. As soon as it was, naturally enough, attempts were made to 'beat the system' (so to speak). There was perhaps a slight note of resignation in Mr Radvan's account of the effects of the layered structure; maybe because he could not show us a piece of felted paper. By contrast, Miss Schmidt's contribution was full of optimism. After all, she had made a kind of 3-D structure with crimped fibres; to be fair, this was perhaps a little side-stepping. The original challenge still stands, namely, to make paper from ordinary papermaking fibres so that a considerable proportion of them are oriented in the Z-direction and we shall never really know how the properties of the sheet, not only the strength in the Z-direction, are affected by such a structure until we have actually made paper of this kind.

Dr Scallan's layered structure is a rather different animal. His approach to explain observed optical properties with a layer model has been criticised. Of course, paper, although layered, does not consist of layers and I believe Dr Scallan knows that himself. I mentioned at the time that I have followed this work for several years. It reminds me a little of my own attempts ten years ago to describe the pore size distribution of paper in terms of a layer model. There is still no satisfactory definition of the thickness of a layer, but a number of unexpected and relevant results and predictions came out of this model nevertheless. A warning therefore to Dr Scallan's critics—the usefulness of such an approach does not necessarily depend on whether the model can be shown to be real: it cannot. The usefulness depends on the extent to which one can use the model as a crutch, so to speak, to arrive at a goal that is quite independent of the construction of the crutch. I am certain that statistics must come into this model somewhere and I wish Dr Scallan success.

In all, the structure of paper, both in the plane and in the thickness is a problem area still very much with us now and for some time to come. I hope that every future symposium at Cambridge or Oxford will provide for time to discuss this truly fundamental subject of our industry.

Dr Goring's paper was the odd one out in this first session, though we would never have forgiven ourselves if we had left it out. It demonstrated in an exciting way that discoveries, really unexpected discoveries, are still possible in our old industry. We all were impressed by the increase in mechanical strength that is caused by ozonisation, but even more by the effect of those mysterious creatures, electrets—charge-bearing spots on the surface, I presume. They remind me of my student days. You will remember that we saw a picture showing Lichtenberg figures. Of course, Georg Christoph Lichtenberg (not a

baron, but the son of an evangelical pastor) was one of the first professors of physics at my old university of Göttingen, a predecessor of my physics teacher, Prof. Pohl to whom I owe many of the demonstrations in my own talk. Gottingen University was founded in 1734 by Elector Georg August II of Hannover who was King George II of England. Lichtenberg travelled quite regularly to this country and, every time he returned, recorded his impressions in his diary and in letters to his friends. One of his observations translates as follows, 'Among the more recent achievements is the ability to review a book without having read it.' Let us hope that we do not give a modern Lichtenberg similar food for thought.