Preferred citation: H.A. Posner. Research at the Institute of Paper Chemistry. In **The role of fundamental research in paper-making**, *Trans. of the VIIth Fund. Res. Symp. Cambridge, 1981*, (Fundamental Research Committee, ed.), pp 987–1000, FRC, Manchester, 2018. DOI: 10.15376/frc.1981.2.987.

RESEARCH AT THE INSTITUTE OF PAPER CHEMISTRY

Harry A Posner, Jr.
The Institute of Paper Chemistry
Appleton, Wisonsin
U.S.A.

Abstract

The primary missions, Research, Education and Information, of the Institute are discussed. The overall organisation, operation and funding of the Institute are described. The process for developing research priorities and programmes and assessing progress is discussed with emphasis on the benefits of industry-Institute interactions. An assessment of the strengths and weaknesses of our present mode of operation is presented.

Introduction

The Institute of Paper Chemistry was founded in October, 1929, in Appleton, Wisconsin. The concepts which led to its founding were developed by a small group of men within the Board of Trustees of Lawrence College (now Lawrence University), a liberal arts institution of distinction in Appleton. The new Institute started operation early in 1930, in close affiliation with Lawrence College, with one full-time staff member and three students. An academic affiliation with Lawrence still continues, although the relationship has become more tenuous and the Institute has functioned separately for many years.

It was the aim of the founding trustees that the Institute become a unique partnership between industry and education, with three specific objectives. Firstly, it was to undertake graduate education in the science and engineering fields to train people for the pulp and paper industry. Secondly, it was to be a

research centre, where both staff and students could engage in a broad programme of pure and applied studies. Thirdly, it was to develop a comprehensive library, not only serving the academic and research activities of the Institute, but providing a central source of information for the pulp and paper industry as a whole. Despite the many changes in society and in the pulp and paper industry over the past half century, the Institute remains dedicated to these three original objectives.

Organisation

The Institute of Paper Chemistry is a private institution, which, in a very real sense, belongs to the pulp and paper industry of the United States. Both governance and basic support are accomplished through the mechanism of "member companies". Any company manufacturing pulp, paper or paper-board in the United States is eligible for membership of the Institute. The members support the Institute through annual dues, which vary in amount with the size of the company.

The administrative organisation of the Institute is summarised in Fig. 1. Governance is vested in a board of Trustees of 24 members, composed of leading executives of the United States pulp and paper industry. Save for the four ex-officio trustees, members of the Board are elected by the member companies. The Board meets periodically, elects the officers of the institution, and establishes the broad policies upon which the operation is based.

Overall responsibility for operation of the Institute rests with the President. He guides all of the activities of the staff of 260 people.

The Vice President (Academic Affairs) administers the educational programmes of the Institute and presides over the faculty and its four academic departments. It should be noted that the 47 members of the faculty also hold key positions in the research staff, so to this extent a matrix organisation is practised. The Academic Vice President is also responsible for

the Information Services Division and its staff of approximately 30 people.

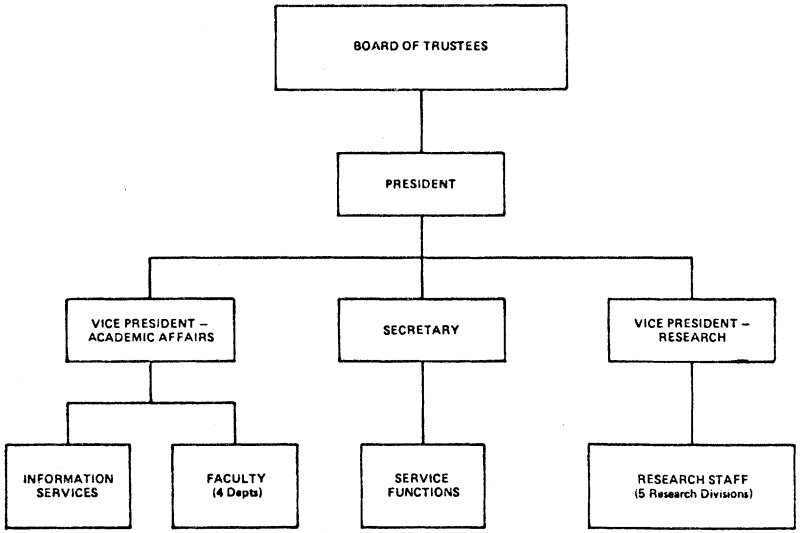

Fig 1—Administrative organization

The Secretary, in addition to his corporate responsibilities to the Board, directs the activities of the various fiscal, legal, personnel, and service groups necessary to the overall operation. Approximately 65 people are involved.

Responsibility for the administration of the various research programmes of the institution lies with the Vice President (Research). Members of the research staff are organised into five divisions, each with a designated Director. The Research Vice President and the five Division Directors constitute the internal group responsible for the planning and the conduct of the staff research programmes.

Currently, the five research divisions, with the principal subdivisions within each, are as shown in Fig. 2. This organisation is an evolving one, reflecting the perceptions of industry needs and the directions of industry progress.

The total research staff numbers about 140 people. Four of the divisions are approximately equal in size, with Forest Biology being somewhat smaller. Although the ratio of professionals to support people varies among divisions, the total number of graduate scientists and engineers is over 100.

Budget

The total Institute budget for the current fiscal year is about $11,000,000: expenditure distribution is shown in Table I. A detailed discussion of the categories under "Research" is given below.

Education	
Graduate Programme	$2,200,000
Continuing Education	$300,000
	$2,500,000
Information Services	$600,000
Research	
Member-funded	$3,600,000
Contract	$3,300,000
	$6,900,000
Analytical Services	$500,000
Capital Expenditures	$500,000
Total Budget	$11,000,000

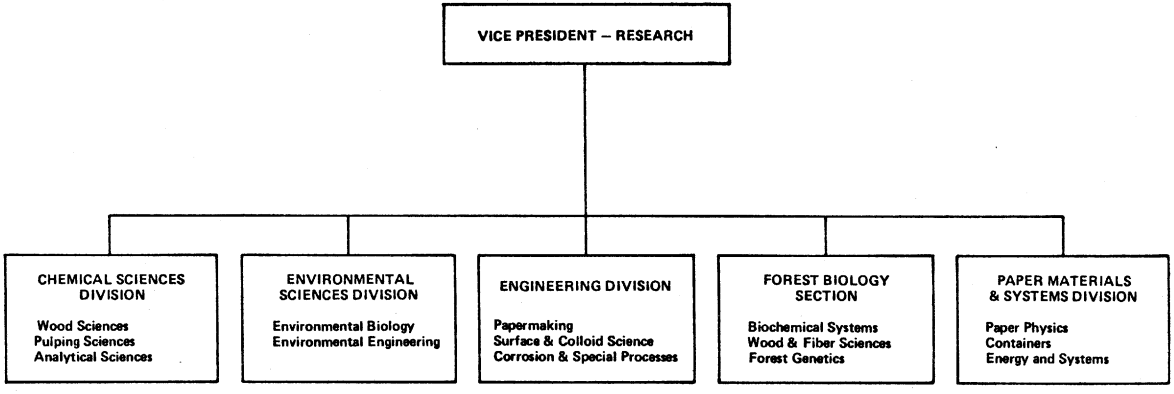

Fig 2—Research organization

On the income side of the budget, it has been noted that the underlying basis of support is the dues paid by member companies of the Institute. This accounts for very nearly half of the total. Other sources of income are contract research and services paid for on a cost-reimbursement basis, research grants, continuing education tuition and fees, subscriptions for information services, and contributions.

Academic Programmes

Before proceeding with a more detailed consideration of the various Institute research programmes it will be as well to discuss briefly the academic activities, in order to keep the whole enterprise in perspective. It is already apparent that, in terms of people and dollars, research is the dominant function of the Institute. The point should be made, however, that the academic and the research programmes are considered to rank equally in importance. The two activities are highly synergistic, and proceed side by side. Although most pulp and paper research institutes throughout the world have a working relationship with a nearby University or Technological Institute, it is the maintenance of a full-blown graduate education programme which distinguishes The Institute of Paper Chemistry from the others.

Academically, the Institute is a graduate school in the natural sciences and engineering. That is, all entering students have already received the Bachelor's degree from some other accredited institution. In most cases, their undergraduate work was in chemistry or chemical engineering, although other disciplines, such as biology, physics, and mechanical engineering, are represented in the student body.

It is the educational objective of the Institute to develop "scientific generalists" or industrial scientists, well versed in several disciplines within the natural sciences and engineering areas. While recognising the need for specialists, it is believed that people with a broad viewpoint, who understand the

inter-relationships among scientific fields and can range across the boundaries of disciplines in their pursuit of understanding, will be essential in guiding this industry to new vistas and new accomplishments.

At both the M.S. and Ph.D. levels, Institute students undertake a broad and highly-interdisciplinary programme of study in biology, chemistry, physics, and engineering, the integrating element comprising systems and situations pertinent to the pulp and paper industry. The Ph.D. candidate then goes on to a concentrated research experience, culminating in the doctoral thesis, an excursion in depth. Such an academic approach is complex and difficult, both for the teacher and the student, but the accomplishments of Institute graduates in the pulp and paper industry indicate that some success has been achieved.

Although it is usually considered a part of the academic effort, research conducted by students in fulfilment of their degree requirements represents an important contribution to the overall research effort. Candidates for the M.S. degree are required to undertake research projects of limited scope, and at any time some 35 to 40 such projects are under way. More significant from the stand-point of research results are the doctoral theses required of Ph.D. candidates. Such studies are almost always fundamental and long range. They are designed to provide new insight and understanding in those scientific fields underlying the technology of the paper industry. Each dissertation requires the full-time effort of the candidate for two or more years, and, with more than thirty under way at any given time, this is a significant research effort.

Academic research is conducted under the supervision of the faculty. The topics chosen by the students tend to reflect closely the research interests of their faculty advisors, as might be expected. Since faculty members are also the key members of the research staff, it follows that there is a close correlation between student and staff research. Student research often provides the fundamental insight needed for more applied staff-research projects.

From its founding, the Institute has tried to make its library actively available to the entire pulp and paper industry. The size and the activity of the Information Services Division is far greater than are required by the staff and student body. The Abstract Bulletin is used widely throughout the world. It is supplemented by numerous bibliographies and literature studies. In more recent years, computerised information retrieval systems have been developed, and are now widely available.

Member-Funded Research

The major research effort of the Institute staff is in a co-ordinated programme of projects underwritten by member company dues. This so-called Funded Research Programme is designed to be of wide interest to the membership and is directed toward major areas of industry need. Most projects are relatively long range. They may be either fundamental or applied, although most projects tend toward the middle ground in this respect. Very often, they serve as the basis and provide the groundwork for further applied or development activity by individual companies.

Table II summarises the current Funded Research Programme. The programme is broad, and heavily orientated toward process studies. Of the eight major areas shown in this breakdown, Production of Wood Pulp, and Paper and Board Production receive the greatest emphasis, and between them account for half of the allocated funds. The structured Programme represents about 90% of the total funded research budget, with the remaining 10% set aside for unspecified exploratory studies.

Funded research projects must be non-proprietary, since the results are quickly made available to the entire Institute membership and to the public. This accounts in large measure for the absence of product development studies in the Programme. While studies of material properties (from raw materials to products) are considered appropriate, product development studies are usually proprietary and inconsistent with the goals of Funded Research.

TABLE II

DUES-FUNDED RESEARCH
July 1, 1980 - June 30, 1981

		Budget $000's	
I.	Tree Propagation		390
	Forest Biology	370	
	Wood and Fiber Science	20	
II.	Production of Wood Pulp		830
	Reactions in Pulping and Bleaching	155	
	Improved Processes for Bleached Chemical Pulp	250	
	Improved High Lignin Pulps	60	
	Alkaline Recovery Systems	190	
	Structure of Fibers Relating to Ultimate Web Properties	45	
	Development and Application of Analytical Techniques	30	
	Corrosion	100	
III.	Secondary Fiber Utilization		43
	Surface Chemistry of Sticky Contaminant Removal	43	
IV.	Paper and Board Production		752
	Surface and Colloid Chemistry	212	
	The Disk Refining Process	130	
	Higher Consistency Processing	110	
	Improved Characterization of Pulps	40	
	Wet Pressing; Process Fundamentals	60	
	Drying; Thermodynamics and Basic Processes	100	
	Corrosion Engineering	100	
V.	Energy and Systems Analysis		355
	Energy and Systems Analysis of Pulp & Paper Mills	260	
	Environmental Systems Simulation	75	
	Pulping and Recovery	20	
VI.	Performance and Properties		270
	Paper and Board	170	
	Corrugated Box Performance	100	
VII.	Converting		155
	Corrugating	155	
VIII.	Waste Treatment Operations		320
	Waste Treatment Plants	75	
	Sludge Disposal Processes	30	
	Development and Evaluation of Methodology for Receiving Water Impact Evaluation	170	
	Control of Slime and Spores	45	
	GRAND TOTAL		$3,115,000

Contract Research and Service

When the nature and the goals of the work are consistent with broad Institute objectives, contract research may be undertaken on behalf of a company, a group of companies, an association, or a government agency. In such cases, the objectives and scope of the study and the disposition of the results are spelled out in a contract entered into in advance. Generally, the results become the exclusive property of the sponsor for a specified period after completion of the work, usually two years, after which they may be made public. It is a requirement of the Institute's non-profit tax-exempt status that all research results must eventually reside in the public domain.

It is axiomatic that a well-balanced and co-ordinated research programme cannot be developed solely on the basis of contract research. Nevertheless, this mechanism for research sponsorship can play an important role in an overall programme in providing the opportunity and the facilities for certain studies, particularly of an applied nature, which might otherwise be most difficult to accomplish.

Certain technical services, of an analytical, paper evaluation, or other nature, may also be undertaken on a cost-reimbursement basis. Routine testing or other services regularly performed by commercial laboratories are not undertaken, but special situations arise where the Institute is able to perform services not readily available elsewhere. The educational and research programmes of the Institute also require that expertise be available in associated service areas.

The Research Staff

The career structure of the research staff is built around the following six grades, with the numbers currently in each grade as indicated:

	Senior Research Associate	11
Professional	Research Associate	26
	Research Fellow	42
	Research Assistant	42
Non-professional	Laboratory Assistant	10
	Office - clerical	9
		140

As indicated, the top three grades are considered to be professional, although a new staff member with a Bachelor's degree and no experience may enter at the Research Assistant level. Professionals may join the staff at any level, depending on their background and qualifications. Promotion to higher levels depends upon performance.

Salaries are determined on an individual basis, within a specified range for each staff grade. The salary ranges are determined and adjusted periodically, to remain competitive with comparable grades in similar institutions in the United States. National salary surveys provide guidance in this respect.

It has been noted that most of the 47 members of the faculty also hold research staff appointments. All of the Senior Research Associates, most of the Research Associates, and some of the Research Fellows are members of the faculty. There is no necessary equivalence between faculty rank and research rank.

Funded Research Planning and Guidance

In its research efforts, the Institute's contribution will be measured largely by the results of the Funded Research Programme. It is essential, therefore, that the Programme be relevant, that it speak to the most important needs of the industry, and that it is carried out effectively. These requirements will be met only if there are effective mechanisms of communication and interaction between the Institute and the industry it serves.

Recognising this need, the Board of Trustees has established and maintains a Research Advisory Committee to work closely with the Institute administration in research planning and guidance. The committee consists of 12 members elected to staggered terms. They represent varied interests: research, technical and operational aspects of the industry; large and small companies; and various end product categories. The committee meets about five times each year with Institute administrative and research leaders.

Since the Research Advisory Committee (RAC) is concerned with overall aspects of the Funded Research Programme, they have established six RAC subcommittees, each concerned with the research in a designated field or area. Members of the subcommittees are chosen for their expertise in the given area, and while most are from Institute member companies, several subcommittees have at least one member from an academic institution or some other "outside" organisation. Subcommittees are functioning in the following areas:

Forest Genetics
Pulping Processes
Paper Properties and Uses
Engineering and Colloid Science
Energy and Systems Analysis
Environmental.

Each RAC subcommittee meets with members of the appropriate Institute Research Division at least twice a year. One such meeting is devoted to preliminary planning of Funded Research projects for the coming year, and the other to an assessment of research results. All member companies are invited to send representatives to at least one such meeting each year.

Responsibility for the planning and assessment of the Funded Research Programme must, of course, rest primarily with the Institute administration and staff. There is a strong input, however, from both the subcommittees and the parent Research Advisory Committee. Specific proposals for new projects usually

originate within each Research Division. After these have been discussed and developed internally, they are considered with the appropriate RAC subcommittee. Following this procedure in all Divisions, a preliminary Funded Research Programme is evolved. This is discussed thoroughly with the Research Advisory Committee in one or two meetings, and revised as desired before adoption. The continuation or termination of existing projects receives the same scrutiny as a part of this process.

Perhaps more than in the consideration of a given Funded Research Programme, the Research Advisory Committee has played a strong role in discerning broad needs and goals and urging that the research staff be developed to meet them. The most notable result is the marked shift in emphasis toward engineering over the past few years. For example, the RAC strongly urged that scientists be added to the staff, and programmes be developed, in corrosion; and this has been done. More recently, greatly increased attention is being paid to energy use and conservation, in part as a result of RAC conviction.

This technique of developing a strong industry advisory committee structure, and working closely with it in research planning and assessment, has been developed during the past few years at the Institute. On the whole, it has worked well, but, as with any such approach, there are both strengths and weaknesses. Its great strength lies in the excellent communication channels which it provides between the Institute staff and their industrial counterparts. It keeps the Institute well informed on industrial developments and future needs and goals are perceived by industry representatives. It also keeps the supporting companies informed as to Institute goals, abilities, and constraints. It permits the development of a broad, co-ordinated programme of many projects and provides an excellent vantage point for the development of perspective. It provides an excellent forum for viewing ongoing projects critically and modifying or terminating those which fail to show promise.

Conversely, the mechanism is ponderous. There are many layers to penetrate to bring about change, and the process is time-consuming. As with any complex structure, the tendency in considering projects and research areas is to migrate toward the safe middle ground. The mundane low-return end of the research spectrum is effectively screened out, but there is also a danger of stifling innovation and of cutting off the high-risk and potentially high-return end as well. The relatively short-range and quick-return project often looks most attractive. Every effort must be made to strike a proper balance in this regard.

On balance, the advisory committee system has worked well, and is considered to be very satisfactory both by the Institute and by its supporting companies.

Discussion

Prof. H. W. Giertz, University of Trondheim, Norway

Having discussed the importance of fundamental research and having heard at this symposium of how many practical achievements and industrial applications have been engendered by fundamental research, I would like to know if anyone has gone over his files to see what proportion of fundamental research projects has actually given rise to useful results? In the research organisation at Trondheim we did analyse the useful returns on fundamental research and concluded that only 15% of projects that began as fundamental research had any ultimate practical use.

Mr. H.A. Posner

We have tried to check back, as you suggest, on several occasions. However, it has always turned out very difficult, for two reasons. Firstly, the records often aren't very good. It is very often the case that to unravel the course of a particular development is impossible without the assistance of the personnel involved. Secondly, we find that much of the research we do has to be considered as building blocks, not of direct relevance to an identifiable end, but nevertheless very important to it. Combinations of apparently unrelated building blocks can, sometimes and in the right hands, be the correct combination for a technical breakthrough. For these reasons we think it very difficult indeed to try to perform the sort of analysis Prof. Giertz mentions.

Dr. J. Mardon, Omni-Continental, USA

Please forgive me if I phrase this question a little tactlessly, but I want to ask about what happened at IPC when it went through its difficult period some ten years ago. At that time, as many people in the industry know, its reputation diminished, so that it made a substantial effort to reverse this change. Could you identify what aspects of IPC's work or organisation you found inadequate, and how you changed your planning in order to remedy the deficiencies?

Mr. H.A. Posner

It is a very long story. Most people are aware that the sticky patch IPC went through in the later sixties-early seventies was partly a reflection of the mood of the times. There were however, some particular factors which contributed more than most to the problems at that time. They were quite easily identified, and all were important.

The institute at that time was trying to support its non-educational faculty on a contract research basis. This is a tough way of supporting yourself under the best circumstances. It seems to me that efficient and successful contract research organisations work very differently from most governmental research institutes. They, like everyone, have good people, and then leave them to make their own contacts and build their own organisations, subject only to the condition that they continue to turn in a profit. As soon as that condition is not met, then they are out.

At the IPC it is difficult to do that, partly because of our educational role. Thus, the use of contract research as a way for university staff to support themselves outside their academic life was one of the factors which led to the institute's difficulties.

A not-unrelated factor was our losing touch with the outside world. As is always the case, researchers would rather talk to one another than to anyone else, being quite capable of concocting enough interesting problems for one another to work on, with absolutely no reference to anyone else. So why go out to find problems? Thus I think the institute had become very much too introspective.

We also had staffing personality problems, of delayed decisions and insufficient flexibility.

Mr. G. Place, Proctor and Gamble, USA

You mentioned that the IPC targets about 50% of its resources in basic research. I believe that the paper industry is going to change its technology radically within the next two decades. What percentage of your institute's research effort is devoted to

major technological changes, discontinuous with existing methods, as opposed to evolutionary upgrades of what we are doing now?

Mr. H.A. Posner

A relatively small percentage, at a guess about 15%, but not more than that.

Mr. G. Place

Is that because you are interacting with an industry that already exists?

Mr. H.A. Posner

Yes, and it is very understandable. The IPC is not looking at things beyond the realms of current paper-making technology, because its emphasis must be on the realistically practicable. We can and do bring up questions of discontinuous change sometimes, but they must be couched in terms of existing practicability. I don't believe it is the role of IPC to undertake that type of research except when an identifiable need for it arises. We must always be aware of what industry sees as the priorities.

Mr. L. Rodes, São Paulo, Brazil

Some years ago you ran a strategic planning exercise in your institute. Would you say it was successful, and, if you were to repeat it, how would you change the way you conducted it?

Mr H.A. Posner

As a matter of fact we are conducting a similar exercise now. There is a wide variety of possible methodologies for such investigations. The one we at IPC selected is that which seems most appropriate to the collection of people involved, not only within but also outside the institute. Even the selection of the methodology has involved not only members of the institute, but also a number of people from industry.

Dr. A.H. Nissan

People have been asking how much of the fundamental research effort in the various institutes has a useful outcome. One study mentioned suggests 15%, which I consider surprisingly high. To understand how this figure comes about, I think perhaps we must appreciate that the term "fundamental research" has two connotations. Thus Sir G.I. Taylor's work on the instability of rotational flow, published in the Royal Society transactions, was pure fundamental research. Studying what happens on a table roll, even when it is the same problem as Sir G.I. Taylor's, should properly be called "Paper Science fundamental research". This is therefore an application of a deeper level of fundamental research, and I presume that this is why such a relatively high proportion of what is understood in the research institute as fundamental research has a successful outcome. Now may I ask Professor Giertz to repeat his earlier question to Mr. Posner, so that others may have a chance of answering it.

Prof. H.W. Giertz

My question to Mr. Posner was, has anyone in your institute looked back through the last fifteen or twenty years' files to try to follow up lines of research, to establish whether or not they led, eventually, to useful results? This is to some degree the matter to be covered by Dr. Scheuring in his paper later today. He will show the technical leader always goes over a project after its completion to try to show what it has led to.

Mr. B.W. Burgess

We find that applications of our work can surprisingly often be traced back to fundamental research. Though we have never conducted an exhuastive examination, it is surprising how often the comment that some piece of work is clearly traceable to such and such past fundamental research is heard. Consider these examples, which all began as fundamental and basic studies: our study of pitch fouling, now being applied in the majority of Canadian mills: similarly our corrosion research, resulting in the Papritection system which greatly extends the life of bleach

plant washers. Dr. Tabor earlier this week mentioned the work of Dr. Atack, whose study of sliding friction gave us a very useful insight into the mechanism of fibre removal in all forms of mechanical pulping. There are other examples too, where fundamental studies at our or other institutes have resulted in significant improvements to industrial processes.

Mr. G. Place

I am concerned that the paper industry must soon face serious changes, and I am trying to discover what role the various institutes are playing in identifying and forcing our attention on these changes. The structure of the funding and managerial control of these institutes suggests, in my experience, that they will be the last places to discover the discontinuities that must occur.

Mr. D. Attwood, PIRA, UK

PIRA is at present involved in pursuing such a discontinuity as those of which you speak, though it is of no help to paper-making. I am speaking of the new electronic information laboratory. This is a discontinuity that will affect us all, though it can only harm the paper industry, which will have to struggle on, trying to compete and think up different uses for paper.

Mr. B.W. Burgess

Mr. Place's question is very important. Part of the brief of our institutes must be to lead the industry, to try to determine what is going to happen in twenty year's time, so as to prepare the industry for it. We spend a lot of time on this. We have a future awareness committee engaged in technological forecasting and we make use of every device we can think of to try to anticipate future technical needs. This committee works alongside our Research Programme Committee, where the summary organisation of our research effort is done. We believe that one mechanism for initiating action on these technical step jumps is to encourage research by our staff on which they do not have to

report. We are concerned that the level of this exploratory research in our institute has declined recently and moves are in hand to reverse this. We believe it to be of the utmost importance that a scientist can retire into a corner to try out his screwy idea before it is exposed to the harsh light of reality.

Dr. R. Martin-Löf

I agree very much with what Mr. Burgess said, with the addition that I believe the government support for our institute adds to the freedom of the scientists to explore less immediately useful directions. Thus a project doesn't have to convince industry of its viability too early.

Dr. A.J. Michell

Perhaps the best example of a discontinuity, though not a very great one, in CSIRO, was the move into composite materials. It required a completely new start by us, with initially no enthusiasm from industry. This has now changed, since we have come up with several interesting inventions and patents.

In CSIRO, being a government body, the advisory committees are purely advisory. All the decision making power lies in the hands of the senior executive, who can see a project started if he feels sufficiently strongly about it.

Mr. E.J. Justus, Beloit Corporation, USA

Discontinuities, doing things differently, always need one or two dedicated people, backed by a courageous organisation, to come to fulfilment. The onus of responsibility for adopting a new idea lies with the paper industry itself. The problem of the transfer of good ideas from laboratory to mill makes demands as great on individual courage as on technology.

Prof. N. Hartler, RIT, Sweden

I think that the industrial committees play a very useful role in directing the institutes' research programmes, but that it is unreasonable to expect them to take much part in

identifying the long range changes, the discontinuities. The reponsibility for this must be with the individual institute staff, who must be sufficiently strong to resist following completely what the industry committee says. They must be forceful enough to be able to see their own ideas through, and good enough that these ideas will be of value. But the responsibility for step changes must be with individuals in the institutes.

Mr. S.O. Dillen, Stora Kopparberg, Sweden

I think there are two aspects of the discontinuity subject, and the answers so far given don't match the question put. The answers tend to have been concerned with the difficulties of adaptation, of the individual effort needed to force changes through, which is indeed one aspect of the matter. But I think that the questions have been asking to what extent research in institutes can hope to recognise the discontinuities: quite another matter. It is by no means self-evident that it is in the institutes' interests to make discontinuous discoveries, because of the drastic effects they would have on the industry.

Dr. A.H. Nissan

That is why they are called discontinuities: some companies discontinue. I have not found a single instance in history of an important or novel idea being born in the mind of the majority. The ideas from which discontinuities stem invariably occur to a minority of one, and they are almost never welcome. We shouldn't be concerned about that, as one of their strengths is their ability to withstand criticism. They will not be valuable if they can't. Anyone with suggestions of how to foster such ideas should please speak up.

Prof. D. Wahren, IPC, USA

On what criteria do the members of the panel believe that a research director should work when trying to judge whether or not to support a new idea, such as might give rise to a discontinuity?

Mr. B.W. Burgess

With difficulty. There are no rules, and such decisions can only be made with support, advice, and, ultimately, courage. Our institute recently moved into bio-technology. We don't know what will result, though we hope it will be useful. We do expect, however, to have to support that work for a good number of years with no returns. The initiative to move into this field came entirely from within the institute, and has had nothing to do with the industry.

Mr. J. Adams, BPBIF, UK

Nothing has been said here about the role of universities in fundamental research. I suggest that they have a much greater likelihood of provoking the development of discontinuities than do the research institutes, because of their greater potential for cross-fertilisation from different disciplines.

And now I would like to ask Professor Göttsching whether he, in view of recent EEC bureaucratic intervention in the matter of the amounts of waste paper to be included in pulp, believes that the European research institutes should work more closely with the industry federations, the better to resist bureaucratic pressures?

Prof. L. Göttsching

You are asking for better co-operation between the research institutes and the industry federations in the various countries of the EEC. This you think would be the way to improve communication between the research institutes and the EEC bureaucracy. But I think that they work very closely together already, at least in West Germany. And then there is the question of who should try to improve this communication, the federations or the institutes. I think it would be a matter for the federations, as they have the necessary power.

Dr. A.H. Nissan

I draw a different conclusion from the recent EEC experience mentioned. I believe there are problems faced by all industries, particularly paper, which are not purely political or commercial, but have also a technological content, such as this one regarding the inclusion of a greater proportion of waste paper in new pulp than hitherto. These problems must be studied within the industry, even at the risk of a disquieting result. It will be impossible to stop that study; so surely it is better that it shouldn't be conducted by outside amateurs, who may well fail to take important technical aspects into consideration. I am certain that it is better in the long term for the industry's research institutes to investigate responsibly and fully the fringe problems such as conservation, pollution and safety.

Dr. R. Martin-Löf

The Swedish experience in the environmental debate was that by taking the lead and the initiative, industry could so improve its relations with the government that its point of view is much more fairly heard. I think the outcome has been greatly more satisfactory to us than it would if the initial study had been left to the National Environmental Board. I think industry must vigorously study its own problems because that is the only way of ensuring that proposed solutions fall within practical technology, and that end products meet the customers' requirements without being hazardous.

Dr. J.E. Luce, International Paper, USA

Returning for a moment to the question of discontinuities, I am sure no-one here believes they are spontaneous. Discontinuities result from the combination of two processes. Firstly, there must be the recognition of a need, that is to say, an overall need, which might be defined by asking "What busines are we in?". Thus in the paper industry we are in the business of substrates, communication, wrapping or cleaning up mess. Secondly, one has to ask oneself what alternative ways are available for satisfying those needs, other than those in current

use. Generally, scientists aren't very good at asking these overall questions, but one thing fundamental researchers are good at is recognising opportunities for satisfying these needs. I suggest that even the largest companies are not able to support truly fundamental research, but they are aware of the needs. Thus the combination necessary for a discontinuity to result can occur if the links between the large company, with its knowledge of the needs, and the fundamental research institute can be strengthened. This I see as the weakest link and one that must be reinforced even if it involves considerable retraining of the people involved.

Mr. G. Place

Dr. Goring said that the greatest ideas can only arise from mountains of solid background work, and I agree with him. But my experience suggests that they usually occur only at interfaces between displines, not within the core of a single discipline. Thus, for them to arise there must be interaction between several sciences besides the one of need. Having created a climate in which there is this required interaction, then the exploratory team investigating it should, I think, be fairly small: one or two of the right people is probably the correct size: with any more it is likely the team would come apart. Thus I think it is worth keeping the number of people involved in the early stages small, at least until they begin to produce some results: then it becomes sensible to increase the effort. One of the roles I believe could be usefully fulfilled by the research institutes is the bringing together of the various disciplines from the universities, with whom they often have closer ties than industry does. The resulting interactions I believe, as I have said, would provide the groundwork for Dr. Goring's flags of achievement.

Mr. P. Waern-Bugge, Stora Kopparberg, Sweden

According to the figures given in the preprints, Europe manufactures some forty million tonnes of paper annually. The larger part of this goes forward to converting in one way or

another, and yet almost all the research funds are spent in the paper industry, and very little on converting. In fact there is an appalling lack of basic research on the downstream side of our industry, which I think reflects a lack of innovative thinking on the part of the end users. If any of the panel would care to elaborate on that I would be the most interested.

Dr. R. Martin-Löf

To a large extent I think rectifying this deficiency should be the responsibility of the paper industry. Converters are the paper industry's customers and as such should be encouraged to develop their uses for paper. Any rapprochement must also include the converting machinery manufacturers, and will take courage and determination. There is every reason for the paper industry to take the initiative in this, and to try to get as much as possible out of the contact. There should be two-way communication, so that, for example, paper can be matched to ink rather than, as is usually the case, the reverse.

Mr. D. Attwood

The paper industry has sometimes been very bad at recognising discontinuities when they occur in the downstream industries. For example, when web offset printing for newsprint was introduced,the paper industry failed to take notice, and all the research had to be done afterwards, at great expense. There are now new developments taking place in packaging, which the paper is not good enough to handle. We seem again to have been caught unawares by these developments, and I suggest that we should spend more time talking to downstream equipment manufacturers in future, to try to be aware of what changes are in the offing.

Mr. E.J. Justus

I want to say a few words in support of Mr. Posner. The strength of the Institute of Paper Chemistry, and the other institutes, lies primarily in their education role. The outstanding young people from these institutes who enter the

industry give it its great strength. Our company does not look to these institutes to do our research work for us. We are interested in the Ph.D. and other research work that is done, but the primary function of these institutes is as centres of educational excellence.

Mr. P. Wrist, Mead Corporation, USA

Mr. Posner described some of the changes that were made in the re-organisation of the IPC. In particular he mentioned that changes were made to the mixture of personalities, which, it was felt, had become too homogeneous. Probably one of the essential ingredients in furthering a discontinuity is a mixture of personalities and disciplines.

The Advisory Committee felt that further re-organisation was still needed, so they tried to advise the institute management of the direction in long-term research where they felt there was need for knowledge. I believe it is in supplying essential understanding that an institute's main purpose lies, rather than the development of this understanding to useful applications.

After considerable discussion, five areas in need of long term investigation were identified. The emphasis on the long term was felt to be important because of the institute's one step removal from the market place; it was felt that the institute should not chase after every short term development of the market, which it couldn't possibly hope to follow because of this position of remove. The five areas have continued important over the past eight or nine years.

The first was the supply of raw materials, the concern being to maintain adequate supplies to ensure the healthy future of the industry. Within this overall title investigations ranged from genetics to pulping yield improvements. The continuing recommendation from this branch of the work has been that the productivity of our eventually finite land resource must be continuously improved.

The second area investigated was energy consumption. It was recognised that the paper industry is highly energy intensive, second only to aluminium smelting. Thus here too, there must be

continual pressure to improve the energy efficiency of the process.

The third area was that the popular view of the environment had seen a discontinuous change, so that many actions acceptable before 1970 were no longer so after 1970. This has created the opportunity for a considerable re-evaluation of the economic factors in decision making in our industry. The initial reaction from the industry was to patch up, and reduce the impact of the waste produced. This approach has been replaced over the years by one in which the total amounts of waste are reduced, which of course has benefitted the first two fields of study.

The fourth area concerned the capital intensiveness of the industry. It is becoming increasingly more costly to introduce a new unit of production in paper-making, and, even without revolutionary change, it is important continuously to improve the process of productivity. This of course involves further investment, and so the process was thoroughly examined to try to reduce some of the capital intensity.

The last area chosen for investigation concerned the fact that very little account of intended end use is ever taken in the design or testing of our products. Q.C. tests tend to be limited to what is easy, without any real evidence that these have much relevance to properties important in the market place. So effort has been spent trying to discover what properties are of importance to end users, to try to optimise the product without excessively increasing raw material demand.

Dr. A.H. Nissan

I appreciate your having made this contribution at this juncture, where I am sure it is appropriate, and thank you for having made it at such short notice.

Dr. A. Mawson, Wiggins Teape, UK

I wish to return to the question of revolutionary change, discontinuities, that we began discussing. It has been proposed that the universities might be the ideal germinating ground for the seeds of such changes, and also that collective

government funding actually acts against the stimulation of revolutionary change. It is indeed true that large government finance (e.g. the EEC) tends to go into the collective interests of the industry, where collaboration presents no threat, and that this tends to promote the status quo. But in the U.K. money for R & D is being put increasingly into specific companies within an industry, which by helping to avoid the problems of confidentiality, opens the possibility of more revolutionary changes. This approach can, of course, give rise to products like Concorde, for which the primary need was never properly identified, and whose spin-off products weren't sufficiently immediately useful to be widely adopted.

The question of whereabouts to find the most fertile ground for revolutionary change has concerned several speakers here, and surely the need for cross-fertilisation must be apparent. But if this cross-fertilisation is to occur within a committee, it must be a committtee of one only, and of course modern specialisation renders such committees very unlikely to have the necessary range of experience. The main problem, therefore, I see as being one of tapping existing sources of knowledge, mainly in universities, which is a slow, laborious job. I myself am trying to undertake it and I seek suggestions as to how I can improve my technique

Dr. J. Colley, APPM Ltd., Australia

Yesterday Professor Judt called upon the Research Institutes of the developed countries to do more work for the benefit of the developing countries. Could you briefly outline the extent to which the CSIRO Division of Chemical Technology answers this call.

Dr. Michell

The CSIRO Division of Chemical Technology has been engaged for some years in the assessment of the pulping qualities of woods from Papua New Guinea and Malaysia and in advising these countries in their negotiations of chip export contracts with pulpwood buyers from the developed countries. The work has also included assessments of the potential of possible re-

afforestation species. The work is being done in collaboration with the forest departments of the countries concerned and has included training programmes for their personnel.

The work was funded initially by the Australian government through the Australian Development Assistance Bureau but more recently funding has been provided by the governments of the participating countries.