Fulmer Newsletter

contract research and engineering in materials and process technology

No.48 August 1982

PRODUCT DESIGN & DEVELOPMENT

NEW OPPORTUNITIES FOR BRITISH INDUSTRY

A most significant event occurred on April 29th, 1982 with the launch by Commercial Union and Legal and General of COGENT LIMITED, a new venture designed to help British industry with finance for the final stages of product design and development projects. This new company has been started in partnership with AICRO, the Association of Independent Contract Research Organisations, of which Fulmer is a prominent member.

The purpose of the new company is to provide support and arrange finance, on a commercial basis, for one of the most difficult stages of the launch of new products and processes, that of technology transfer between the research laboratory and the factory floor. The new company thus closes the final gap in the development chain not previously filled by government or private enterprise money.

As is well known to readers of this Newsletter, Government finance through the Requirements Boards, NRDC and the PPDS (Product and Processes Development Scheme) has been available for many years to help fund the necessary research and development before new products and processes can be produced, and in the PPDS scheme to help to provide 25% of the commercial launching finance required. What had not been available previously is money specifically designed to be spent in the research laboratory which has developed the requisite expertise and facilitate the transfer of technology on the factory floor of the recipient company in the form of new products and processes. The lack of recognition of the importance of this final step, and hence the lack of finance available for it, has been one of the major reasons for the poor new products and process development performance of British industry since the war. Hence the great significance of the new Cogent company.

Mr. Kenneth Evans, General Manager, Commercial Union Assurance Company Limited, presiding at the COGENT launch. On his right are Professor Ball, Chairman of Legal and General and Mr. Robson, President of AICRO. On his left Mr. Gray, Chief Executive of Cogent Limited and Dr. Duckworth, Managing Director of Fulmer Research Institute Limited.

This lack of recognition has been due to a persistent belief in government and private industry circles that once the basic research and development programme has been completed the industrial company interested in taking the venture further will have, within its own organisation, sufficient resources and skills to complete the process. This ignores the historical fact that expertise rests in people and not in paper reports. It has also not been recognised that the exploiting company, which will have committed as much of its resources as it can to the promulgation of the venture, will often find it difficult to provide R. & D. finance to pay for the process of technology transfer. Cogent Limited provides the essential ingredients to facilitate technology transfer by bringing together within one organisation the relevant technology and commercial skills backed up by the ability to arrange the necessary finance.

With the recent introduction by the Design Council of an improved Design Advisory Service, with £3M of government money (a venture also inspired in part by the presence of AICRO members at the Design Seminar held by the Prime Minister in January), the cycle of finance available to British industry to move up-market in product design and development is now complete. The new Design Council scheme provides up to 15 days of free design consultancy, with the option of a further 15 days half cost consultancy. Companies anxious to assess their product range with a view to determining its future viability and the need for innovation can thus now do so at little or no cost to themselves.

Once opportunities for innovation have been identified the Government's Requirements Boards are only too keen to provide the necessary research and development money for essential development. When this is complete and the new product's commercial viability has been established in the research laboratory, but not yet on the factory floor, Cogent is available to complete the process of technology transfer. There is thus little excuse now, other than inertia, for British companies not to move to the forefront of new product technology, and move up-market into higher added value products essential for Britain's future commercial success.

Fulmer can play an important, or even an essential, part throughout all these processes of evaluation, design, research, development, technology transfer and production. Some examples of our previous successes in enabling companies to launch new products were detailed in our Newsletter No.43 of August 1980. These included the Superdart Marksman Training System, Tension Meters for lift and radio aerials, the Black and Decker work bench, and permanent wear soft contact lenses. A brief description of some of our recent product developments is given overleaf.

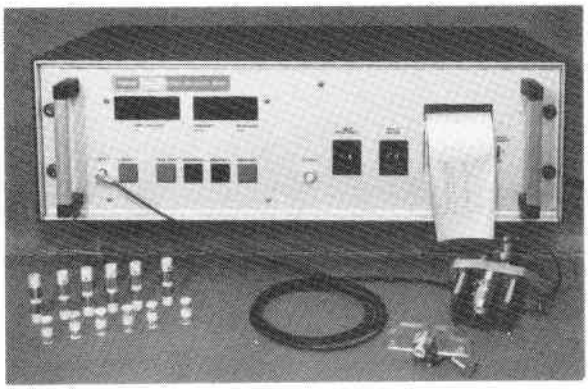
Magnetic Tape Abrasivity Tester

At a Fulmer Open Day in 1971 a major user of magnetic tape in computer applications complained that occasional "rogue" tapes caused excessive wear of recording heads, leading to a loss of vital information. He bemoaned the fact that there was no readily available means of assessing the abrasivity of magnetic tapes.

With the help of Government finance Fulmer commenced a programme of research and development which resulted in the production of a simple prototype magnetic tape abrasivity tester, which related tape abrasivity to the wearing away, and hence the increase in resistance, of a thin nichrome film on a ceramic substrate.

At this stage the Government funding was supported by money from a consortium of magnetic tape producers, who were clearly anxious to improve the quality of their own magnetic tapes and to have a ready means of quality control. The prototype instrument has now been developed into the commercial machine shown in the photograph, and this machine is now available from Fulmer Components Limited at a basic price of £3,600. It will determine the abrasivity index of a particular tape within the first 100ft.

Further information: Dr. G. I. Williams
Fulmer Components



Oil Abrasivity Monitor

A development of the tape abrasivity instrument is a device using the same principle of the wearing away of a thin film, this time exposed to a stream of oil or similar liquid. Once again, a prototype of this equipment has been designed and developed at Fulmer Research Laboratories and considerable interest in its performance has been shown by a wide variety of users in the oil, engine, hydraulics, machine tool, and other industries.

With the help of the financial arrangements already referred to on the previous page commercial instruments will be produced for evaluation in their own particular applications by all these different types of users.

Further information: Dr. G. I. Williams
Fulmer Research Laboratories

PVdF Film

The piezoelectric and pyroelectric properties of PVdF film have been known since 1969. This film has properties which enable it to be used in applications where the ceramic materials cannot compete; in particular its flexibility and the fact that it can be produced in large areas. There has not, until recently, been an indigenous source of this material in the U.K., and even the supplies available from outside the U.K. have been variable in quality and sold at a relatively high price.

These factors tend to militate against the extended use of PVdF in a very wide variety of applications for which it is suitable. These include :

Telephone microphones
Hi-fi loudspeakers
Heat detection
Underwater transducers
Intruder detection
Traffic sensing
Voltage generating pressure switches
Impact measuring
Heat monitoring
Ultrasonic imaging
Thermal imaging
Laser beam profiling

With the help of a consortium of potential users and, again, with Government finance, Yarsley Research Laboratories is now well advanced in a process for producing poled, metallised PVdF film as well as the unmetallised variety, on a commercial scale, of a consistent quality and at a reasonable price. Under present arrangements members of the consortium helping to finance the project have naturally had priority in availability of supplies, but from 1st January, 1983 the film will be available on a commercial basis.

Typical properties of a PVdF film are as follows:-

Density	1.78 g/cm^3
Piezoelectric coefficient (d_{31})	20 pC/N
Tensile strength at break	200-300 x 10^6 Nm^{-2} (machine direction) 30-60 x 10^6 (transverse direction)
Elongation at break	10-50% (machine direction) 300-500% (transverse direction)
Tensile modulus	2000-3000 x 10^6 Nm^{-2} (machine direction) 2000-2500 x 10^6 Nm^{-2} (transverse direction)
Dielectric constant at 1KHz	12
Dielectric loss tangent at 1KHz	0.02-0.03
Dielectric breakdown strength	150-300 KV mm^{-1}
Volume resistivity	10^{13} ohm.m

Further information: Mr. W. Flavell
Yarsley Research Laboratories

Diamond Colorimeter

The NIH (not invented here) syndrome is a well known phenomenon in the U.K. and has, again, been one of the factors inhibiting British industry from making maximum use of the skill and expertise available within this country. To show that Fulmer itself does not suffer from this particular complaint we have recently licensed, from the Israeli company of Zvi Yehuda Limited, an instrument to classify the colour of polished and unpolished diamonds. To those unfamiliar with this particular characteristic of the precious stone, and who thought it was just brilliant white, the particular tone of white can vary from blue to green to straw coloured: a phenomenon not unfamiliar to viewers of recent ICI Dulux Paint adverts.

A blue stone is the most valuable, a fawn one the least precious. While those skilled in the trade may pride themselves on their ability to correctly classify polished stones, they do occasionally make mistakes and, of course, no one has the ability to classify by eye the colour of an unpolished stone; this the machine is able to do.

Further information: Dr. G. I. Williams - Fulmer Research Laboratories

Fulmer Oriented in Orient

South East Asia is recognised as one of the major growth regions in the world and will remain so for the foreseeable future. Countries such as Malaysia and Indonesia are rich in natural resources ranging from rubber and palm oil to vast mineral deposits. They also have great reserves of oil and natural gas; in fact all the natural ingredients for economic growth. Industrial development is required on an unprecedented scale to allow the natural talents of the indigenous populations to be harnessed to achieve the growth required.

More advanced technology is needed to promote this industrialisation of the region and thus a vast market exists for British contract research and development expertise. For this reason Fulmer has recently established a laboratory in Singapore. This country is recognised as the communications and technological centre of the region. The laboratory is a joint venture with a local partner, Mr. F. W. Kam of Chemical Laboratory (S) Pte Ltd. who over the last 10 years has built up a chain of analytical and industrial laboratories in Singapore and Malaysia. Mr. D. C. Foreman, formerly manager of the Polymer Engineering Division at Fulmer's subsidiary Yarsley Technical Centre, has been appointed General Manager of the new company, FULMER RESEARCH AND DEVELOPMENT (SINGAPORE) PTE. LTD. Although already in business the company will be formally launched on September 15th 1982 when a seminar will be held in the Tanglin Club, Singapore, entitled R. & D. in Manufacturing Industry.

Initially the Company will concentrate on polymer and metallurgical engineering development and testing services, but other services in which Fulmer Research Institute has expertise will be provided locally as the demand grows. Further Fulmer companies will be set up in other countries in South East Asia when the Singapore venture has been fully established.

Further information: Mr. M. A. P. Dewey
Fulmer Research Institute

Mr. F. W. Kam

Design Appraisal Service

The Yarsley Technical Centre at Redhill has been consulted on problems of plastics part failure in service many hundreds of times during recent years, and has found that mould design is the most frequent cause of such difficulties. It is calculated that an average expenditure of between £150 and £250 would have saved the manufacturers unnecessary costs ranging from £1,000 to £20,000. Many of these companies are highly skilled in the design of their own type of product but lack experience in the more specialised areas of plastics.

Yarsley now offer to help such companies through their Design Appraisal Service. The client submits drawings of the proposed item and the Yarsley panel, comprising material technologists, component and mould designers and general process trouble shooters, will suggest any modifications that may be advisable.

A further service offered by Yarsley is an intensive short course consisting of a series of fully illustrated lectures, together with 'modules' of information studied by the trainee before entering the course, and retained by him for further reference when he has completed it. The student is given basic information on the various mould parts and systems, and taught to think out his own design decision-making processes leading to a logical approach to mould design.

Further information: Mr. M. A. P. Dewey
Yarsley Technical Centre

Product Design & Formulation

The wide experience of Yarsley Research Laboratories can be drawn upon to formulate proprietary products of a chemical nature. Such products are usually complex mixtures, the components of which must be carefully selected to obtain the best performance. Usually it is not enough to know merely the general chemical type of the components; the precise make-up can be all important in formulating a successful product. Equally important can be the presence of components which are needed in only small quantities, but are essential for a satisfactory performance. Such components, possibly only in traces, may be overlooked on analysis and the need for them may be apparent only through experience.

Equipment is available to undertake research and development work and in many cases to produce trial batches of sufficient size for market research purposes.

Further information: Mr. W. Flavell
Yarsley Research Laboratories

Production Engineering Division

Following the recent decision to diversify the activities of the Polymer Engineering Division at Yarsley Technical Centre, Dick Jones has been recruited to head the new Production Engineering Division.

He was formerly Manufacturing Director of Prince Machines Ltd., who make crankshaft grinding machines. He also has extensive production engineering experience in the fields of electronics and precision mechanical engineering. After taking his apprenticeship in aircraft engineering he worked for the metrology division of Rank Precision Industries, the computer peripherals company Burroughs Machines, as well as Pye Unicam who make scientific analytical instruments, and the carbon dioxide division of The Distillers Company.

Current Awareness Service

The information services offered by Yarsley Research Laboratories include the provision of confidential CURRENT AWARENESS REPORTS on behalf of individual clients which give a bi-monthly up-date of developments in a particular field. Examples of specific subjects within the scope of this service include:- ENGINEERING PLASTICS : PLASTICS IN AUTOMOBILES : POLYMER ALLOYS : ENVIRONMENTAL ASPECTS OF PLASTICS : PROCESSING REFINEMENTS IN RELATION TO INJECTION MOULDING OR EXTRUSION.

Further information: Mr. J. A. Shelton - Yarsley Research Laboratories

Seminars on .....

Impact Testing

On 12th May 1982 Yarsley Technical Centre organised a one-day seminar on UNDERSTANDING IMPACT PERFORMANCE which was attended by 25 delegates from the plastics industry and higher education.

Dr. R. Moore, of I.C.I. Ltd., and Dr. P. Reed, of Queen Mary College, gave detailed presentations of their informative research in this field and a practical demonstration of these techniques was given by J. Gosden and E. Henry using the Yarsley Instrumented Falling Weight Impact Machine (IFWIM). The seminar concluded with an open discussion session which confirmed that there is widespread interest in this relatively new area of testing and therefore many companies in the plastics industry may have specific interest in Yarsley's facilities for testing and supplying suitable apparatus.

Further information: Mr. M. A. P. Dewey
Yarsley Technical Centre

Process Plant

A seminar to discuss the R. & D. requirements of the process plant industry, and particularly of the food and brewing sectors, was held at the Fulmer Research Institute on 14th April 1982. The seminar was attended by representatives from many of the user companies in the industry and after a wide ranging discussion, considerable interest was expressed in the following topics:

Corrosion problems concerned with the deposition of chlorides on to stainless steel.

Suitability of plastics for tanks in the food industry.

Hygienic joints and surfaces in stainless steel components used in the food industry.

Development of standards for process plant components.

Development of low energy consuming process as an alternative to spray drying.

Fulmer is now consulting other firms in the industry to determine whether there is sufficient support for R. & D. in these subjects to justify formulating projects for multi-client support.

Any companies interested in further discussion should contact Mr. M.A.P. Dewey – Yarsley Technical Centre.

Project Planning and Control for Research Managers

2E 500/108 28 - 29 OCTOBER 1982

2E 500/109 25 - 26 NOVEMBER 1982

The seminar fee is £250 (+ VAT for U.K. participants) inclusive of accommodation and meals.

Further information: Mr. D. G. S. Davies
Fulmer Research Laboratories

Paint Systems for Lining Chemical Tankers

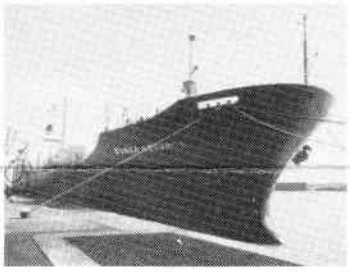
During 1969-1971 an extensive test programme was carried out at Yarsley Research Laboratories at the request of CAMMELL LAIRD SHIPBUILDERS. The aim of this programme was to evaluate 8 paint systems of 3 types : zinc silicate, epoxy and polyurethane for their new chemical carrier ships. In 1973 a second programme of testing marine tank lining paints was initiated, this time under private contract with a paint manufacturer, to investigate certain special aspects of paint performance, under hydrostatic pressure of solvents or their jet action (erosion) when pumping cargoes, and the effects of the cleaning methods ("Butterworthing").

Since completion of this second programme further extensive work on ship painting, including the development of reactive paints and under-water painting systems, has been carried out.

Yarsley Research has also been involved in various legal disputes and court action between paint manufacturers and ship owners/traders, relating to the paint performance in shipping chemicals. This has required ship inspections in Australia, and visits to New York Courts of Law.

At the present time the company is negotiating another test programme with an American paint manufacturer to a) tighten up their "compatibility list", b) evaluate new tank lining paint and c) develop an "early warning system". Effects of paint application under practical "non-ideal" conditions will also be investigated.

Further information: Mr. W. Mikucki
Yarsley Research Laboratories



Powder Coatings Produced by Spray-Drying Techniques

Manufacturers of major powder coating materials and equipment met at Yarsley Research Laboratories in April 1982 to discuss a proposed multi-client research project on the DEVELOPMENT OF SPRAY DRYING TECHNIQUES FOR POWDER COATING PRODUCTION.

Various advantages, both real and speculative of spray-drying as compared with the conventional method of extrusion/grinding were proposed. The general consensus was that the better control of particle size and the spherical shape achieved by spray-drying could be regarded as a real improvement, although many other alleged advantages needed further experimental proof: e.g. the possibility of formulating metallic finishes, no fines (below 10u), improved charging and charge retention, low temperature curing, thinner coatings etc.

A programme of work was proposed of 1 year duration at a cost of £48,000 shared equally between the sponsors. The Yarsley proposal outlined an experimental programme aimed at preparing resin powders from aqueous dispersions, formulation of pigmented coatings and their evaluation. Both spray-drying equipment (NIRO ATOMISER) and electrostatic powder gun (VOLSTATIC) are available at Ashtead Laboratories.

At the conclusion of the meeting it was agreed that the next step would be for YRL to prepare samples of spray-dried powders from suitably formulated aqueous dispersions, for evaluation by the participating companies. These will also be available to other interested parties.

Further information: Mr. W. Mikucki
Yarsley Research Laboratories

FEATURE ARTICLE NO. 1

With effect from this issue of the FULMER NEWSLETTER, we shall be including a feature article by one of our staff on a topic of current interest and in which the role of R. & D. is of particular significance.

Some Current Facts Relating to Plastics in the Car Industry by J. A. Shelton

The more reliable and efficient they become, the more we accept and take for granted our modern cars. We also accept, indeed almost demand, a degree of sophistication in terms of "gimmicks", electrically-operated windows, warning lights and graphics on the instrument panel, etc. etc., which have only been made practicable by advanced and modern materials technology. When we talk of plastics, we are talking really of synthetics across-the-board, for among these are the man-made fibre fabrics and adhesives. Insofar as moulded or fabricated components are concerned, there is now a vast spectrum of materials "on offer" to the motor industry ranging from the ageing phenolics to the mineral and/or fibre filled engineering polymers of more recent vintage. The motor car cannot of course be thought of as a single component; it is in fact a complex assembly of bits and pieces with a wheel at each corner, each bit and each piece being totally essential for one reason or another, these reasons including performance, safety, aesthetics, comfort, etc. Unlike the pioneering days of the aircraft industry, a certain model of car is not born as the brain-child of a designer with a clean piece of paper on his drawing board, but is the result of specialist teams working down-stream of the stylists, each team responsible for a particular part or component, such as chassis, wheel assembly, seating or whatever. Once the stylists have decided what you and I are likely to favour in 5 years from now, it is then up to the nuts and bolts engineers to accommodate their particular baby within that aesthetic shell.

It is at this point when new materials' technology can be considered by such engineers either to a) improve the efficiency of the component b) to lose a few pounds in weight c) to improve the processing or manufacturing technique, or d) to lessen the cost of the component. So far as the motor industry goes, the two prime requisites when viewing alternative materials are: 1) reduction in part cost, or 2) an improved cost/performance ratio.

It should also be emphasised at this early stage that the car industry is also very safety conscious, and will not reduce production or part cost at the expense of safety. Indeed, they will adopt the belt and braces principle to any component which has a structural role to play in order to be certain that a catastrophic failure will not occur under "normal" driving conditions – and "normal" can include drivers mounting curbs at speeds which put a tremendous stress on the wheel and axle assembly. So, although to the layman (sorry – layperson) it would seem a simple matter to substitute one of our super synthetic composites for, say a metal casting, the motor engineer must be 101% certain before he can make the substitution, and it is at this point that two problems arise. Firstly, the plastics industry does not produce data of real practical use to the motor engineer. In other words, the properties of a metal box-section, tube-section, or T-section are well documented, and since the car of today is in fact an assembly of such components, such data is essential to the car engineer. With plastics, no such data exists, and tables of physical, mechanical, and chemical properties of a specific resin are more or less valueless. Possibly the closest the plastics industry has come to producing such data is in pultruded sections. The car engineer therefore has to make up a components of section and determine its properties before he can consider it for a structural unit. All this takes time – a lot of time – for it must be remembered that any new component which fails on a production model and which is associated with ultimate safety (e.g. steering, brakes, suspension, etc.) will result in a "re-call" or total shut-down of the production line – what is termed a "line-stopper", – resulting in astronomical costs to the company. It must also be remembered that "academic" knowledge of materials is not sufficient in such an industry, for there is no substitute for practical testing in every sense of the word. One brief example will suffice on this point. Consider replacing a metal water pump pulley wheel by one of plastics. No problem – there are a number of thermoplastics candidates, and nylon is as good as any. All is fine until the belt begins to slip – end of pulley!

New material technology cannot be introduced into a current production model, so therefore any design modifications will be introduced gradually rather than radically. The motor materials engineer is therefore constantly on the look-out for likely alternatives that can be considered for the model still in draft form. As stated earlier, the motor industry is still essentially in the metals era (so far as structural components go) and is very knowledgeable of their application. With plastics there is a need – an essential need – to design a component to suit the inherent and particular properties of polymers. This prerequisite can mean the difference between success or failure. Success will breed confidence in the long-term so it is in the interests of the plastics "industry" to approach this market realistically, rather than arrive on the chief designer's door-step bearing the polymeric successor to sliced bread.

The current interests of the motor industry appear to centre around three main areas when considering "structural" rather than "decorative" components. These are: 1) RIM Technology, 2) Composites, 3) Adhesives.

The RIM process is an interesting one in that it allows large area components to be made at low pressures as compared with injection moulding. What is of interest to the car makers is an alternative to the urethanes. At the moment, the nylons are the only likely contenders, and in view of their versatility spectrum they could receive a lot of attention in the near future. It is unlikely however that RIM technology will be applied to structural assemblies which are also considered to be load-bearing, such as doors. The more obvious uses are in the bonnet and boot lids in the initial stages.

Composites based on a thermoplastics matrix are arousing interest in a number of industrial sectors, but their use in automobiles must be viewed with caution. All thermoplastics have two inherent problems, 1) they are temperature-sensitive, and 2) they are subject to creep; the two being obviously related. The very make-up of these long-chain carbon-based structures allows them to be pushed around with heat and pressure in, say, injection moulding, but there is a penalty to pay for this. The use of short fibre (glass) reinforcement will reduce the creep tendency but only by using continuous fibre can the creep be virtually eliminated. The use of any plastics on the external surfaces is limited by the temperatures experienced in the stoving oven in the painting process. In under-the-bonnet applications, any component coming into contact with the lubrication system must be able to withstand temperatures up to 140°C since the oil in a hard-worked engine can reach this temperature. The thermosets, and the phenolics in particular, are experiencing a healthy revival with new grades specifically made for GRP work (including filament winding) with realistic or commercial curing rates. They also have good fire retardant properties, which is a valuable bonus these days. The filament winding process must have a good potential in the car industry, not only for items such as steering wheels and perhaps exhaust systems, but also for "chunky" components currently in metal. The speeds now attainable are of interest to the manufacturer of mass units, and it is possible, by the use of multi-heads, to use a mixture of fibres i.e. glass or carbon, and this means that the expensive carbon fibre need only be used in those areas during winding where its specific strength properties are required.

The motor industry in general is very keen to use high-strength adhesives to stick the bodywork together in place of the spot-welding method currently used. Work in using adhesives for this purpose is already well advanced in Japan. The adhesive requires to be specially formulated as it has to meet a very demanding specification, not only in terms of strength but also in terms of temperature. One of the factors to be considered when talking of glueing bodies together or using plastics for structural applications is the difficulty of repairing a damaged car. In the case of a welded body, the repairer can cut and re-weld, but if an adhesive joint is used, this would render the body unrepairable by the usual methods and one would have to resort to a "bolt-up" alternative to repair a damaged section ..... but then a bonnet or boot lid in SMC raises a similar question mark. No doubt the polymer chemist will, given time, come up with an effective antibiotic for use by the car surgeon.

Vision On 1

The "machine" with which a team from Yarsley Technical Centre won the BBC Egg Race Competition in May this year.

Vision On 2

The loss of H.M.S. Sheffield, Ardent and Antelope in the Falklands crisis raised the question as to whether aluminium, used in their construction, posed a particular fire hazard under battle conditions. As a result, a television crew visited the Fulmer Research Laboratories in May to record the views of Mr. G. B. Brook on its fire potential. Practical tests showing that aluminium melted but did not in fact ignite were filmed and the recordings were edited and shown in the television feature "Ship Shape", which was a special investigation into the loss of these ships. Part of the Fulmer contribution was also shown on ITN's "News at Ten".

New Faces ....

ED SOJA is the new manager of the Fire Department at Yarsley Technical Centre. Previously he had been carrying out research at Edinburgh University into fire risk assessment of hospitals. He holds an honours degree in chemical engineering and spent five years as a teacher in secondary education.

PATRICK FINLAY is a chartered production engineer with a background in automation and robotics. After his first degree he worked for Metal Box Ltd. and I.C.I. Ltd. and received his Ph.D. for a study of the potential for advanced technology in the pharmaceutical industry. He is applying his robotics expertise to turnkey projects at Fulmer Research Laboratories.

LAURIE TURNER

It is with sadness that we have to record the death in June of Laurie Turner who specialised in polymer physics and processing of plastics at the Yarsley Technical Centre.

He joined Yarsley Research Laboratories in 1956 as a Group Head and subsequently was elected to the Board of Directors. His knowledge of plastics materials was considerable, from the early uses of Celluloid - through his position of Development Manager with Halex in the 1940's - to the sophisticated engineering polymers we know today.

In the course of his involvement in processing of plastics he became particularly interested in their rheological properties at a time when academic understanding of these long-chain polymers was still very much a "grey area".

Laurie played an active role in the Plastics & Rubber Institute, of which he was a Fellow, and was awarded the Institute's Silver Medal.

He always remained a humble man in the nicest sense of the word, and devoted much of hs time latterly to his theological interests which he approached with the same searching enthusiasm that he applied to his work.

We will miss his cheerful disposition which, despite many years of constant battles against ill-health, was always there. We shall also miss his valuable contribution to our organisation. It is particularly gratifying to mention that we have received a number of letters from clients and business associates extending their sympathy and appreciation of Laurie.

Award for Metallography

Dr. I. Saunderson of Fulmer Research Laboratories was awarded second price in Category B of the 1981 METASERV competition. The basic aim of the competition is to encourage a high standard of micrography and is sponsored by the Institution of Metallurgists. Category B covers optical and other techniques.

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