of a mechanism of removal of the polymer spot from the rotor. It is noteworthy that regression coefficients for a and b indicate adhesion could depend on $\sqrt{(a/b)}$ in such a way that highest precision corresponds to $a = b$ (circular spots).

For thick spots, the adhesion becomes significantly dependent on thickness. Thicker spots have been observed to have a more conical shape and uneven thickness distribution. Thin spots are more even in their thickness distribution, almost flat rather than conical. After adhesive failure under the highest point, the centrifugal force will have an uneven distribution which will be a function of the thickness distribution. The applied force will be insufficient to overcome the adhesion at the edge of the thick sample, and only the major portion of the spot will fail and be removed. The periphery of the spot will be sheared through, which accounts for the portions of sample left on the rotor as a peripheral ring after the testing of thick, unevenly shaped spots. Under these conditions the assumptions made in the derivation of the equation for the calculation of the adhesive force[1] no longer hold. Consequently, the high test values observed for thick, uneven spots are in excess of the adhesive force and are rejected. In contrast, thin, almost flat, spots of even thickness distribution would be expected to fail evenly and completely, leaving no peripheral ring as has been observed.

The precision of the ultracentrifugal adhesion measurement can be improved by using uniformly shaped samples (preferably circular) of uniform but not necessarily constant thickness. The detailed statistical analysis indicates that within the 10% reported error the measurement of adhesion by ultracentrifugation is independent of sample geometry but very much dependent on chemical and polymer factors.

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POLYMER AND FIBER MICROSCOPY SOCIETY

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ABSTRACTS OF PAPERS OF THE FOURTH MEETING

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Needs of Microscopists and Needs of Management for Microscopy

GEORGE L. ROYER, *Administrative Director, Research Laboratories, American Cyanamid Company, Stamford, Connecticut*

The microscopist as a specialist has certain needs as a professional which demand consideration by management. These must show an emphasis on opportunity to do interesting, worthwhile, and challenging work, an environment where scientific accomplishments are given full recognition, and opportunity to grow professionally through publications, study, and scientific work.

Management has a need of outstanding creative scientific work in basic and applied fields, a need which directly or indirectly is of economic value. The needs often bring pressures on the scientist and are misunderstood by him and thought to be in conflict with his own. Management and the scientist must work together if the needs of both are to be be satisfied.

Seeing Problems of Visual Microscopy

OSCAR W. RICHARDS, *American Optical Company, Research Department, Southbridge, Massachusetts*

Successful microscopy requires a correctly magnified image of a properly prepared specimen and adequate means of detecting and analyzing the information in the image. The human eye usually is the detector, viewing either the image directly or a record of the image, such as a photograph or cathode ray trace. Seeing requires that enough light of proper quality (intensity and color) be on the retina of the eye long enough to be coded into nerve impulses and for the impulses to be conducted to the brain and integrated into consciousness. Age, state of health, glare, and immediate adaptation modify vision. Seeing is a learned ability and training can improve it. Some of the basic factors of vision—size, contrast, color, acuity, radiation, etc.—are discussed as determiners of what can be seen with a microscope.

Photomicrography of Fiber and Polymer Surfaces

PETER BARTELS, *E. Leitz, Incorporated, New York, New York*

The photomicrography of fiber and polymer surfaces involves some specific difficulties. In most cases contradictory requirements have to be fulfilled, such as high resolution and considerable depth of field. Since there is a quantitative relationship between total magnification of the optical system and depth of field, with the numerical aperture of the objective as parameter, one may calculate what degree of surface curvature or relief may be magnified satisfactorily by conventional methods, conventional means. In many cases unorthodox methods of illumination and a selection of optics originally designed for other purposes will lead to satisfactory results.

Simple Physical Methods of Producing Contrast in Fibrous Structures

SANFORD B. NEWMAN, *National Bureau of Standards, Washington, D. C.*

Although the double-diaphragm method of oblique illumination is particularly applicable to isotropic materials it has apparently been rarely applied to fibers. Commercial fibers are used to demonstrate the type of contrast obtainable with the method and the results are compared with other optical techniques. These include strip diffraction plates and diaphragms for producing phase and anoptral contrast.

In addition, some applications to fibers of multiple-beam interferometry and x-ray microscopy (PMR) are discussed. The production of the various optical systems are described in detail.

A Study of a Textile with Electron, Light and X-Ray Microscopy

SELBY E. SUMMERS and ERNEST F. FULLAM, *Ernest F. Fullam, Incorporated, Schenectady, New York*

The study of textiles involves the application of many different techniques and instruments. The techniques and information obtained in the study of a textile with the use of electron, light, and x-ray microscopy are discussed. Among the various techniques used are replicating and direct viewing in the electron microscope, mounting and sectioning for the light microscope, and a lead shadowing technique for viewing with the x-ray microscope. The value of a coordinated program utilizing these three instruments will be stressed.

The Morphology of Crazing in Some Amorphous Thermoplastics

WALTER D. NIEGISCH, *Union Carbide Plastics Company, Research Center, Bound Brook, New Jersey*

A combined light and electron microscopical study of crazing in several compression- and injection-molded amorphous thermoplastics has revealed that, initially, crazes formed by the application of a uniaxial tensile stress are not void. Rather, matter oriented in the direction of the imposed stress has been found throughout the entire depth of craze crevices during the early stages of craze formation, as well as in numerous more fully developed crazes. This *crazed matter* may be thought of as connective tissue; it presumably accounts for the high residual strength of a badly crazed specimen.

Micromorphology of Heterogeneous Polymers

R. J. CLARK and G. C. CLAVER, *Monsanto Chemical Company, Plastics Division, Springfield, Massachusetts*

The micromorphology, as revealed by positive-ion etching, of several polymer systems, has been studied. Semicrystalline polymers, block copolymers, and polyblends were included in the study. This variety of systems was chosen to determine the selectivity of the method in respect to the state of a given polymer or polymer species. The structure as revealed is correlated with the optical and mechanical properties of the material. Polystyrene and polyethylene are the semicrystalline materials and styrene–methylmethacrylate is the block copolymer; various rubber–styrene polyblends are also used in the study.

Morphology of Polymer Crystals

P. H. GEIL, *Polychemicals Department, du Pont Experimental Station, Wilmington, Delaware*
R. G. SCOTT, *Textile Fibers Department, du Pont Experimental Station, Wilmington, Delaware*

While many polymers crystallize in the form of lamellae, some crystallize from solution in the form of hollow pyramids as well as lamellae. New crystallographic concepts are required to explain these modes of crystallization. The packing of chain folds on the crystal surfaces and the packing of molecular segments within the crystal lattice influence subsequent changes in crystal structure induced by physical treatment. The effects of solvent removal on hollow pyramidal crystals, and the effects of annealing and mechanical working are discussed.

Crystals of Polytetrafluoroethylene Grown from Solution

N. K. J. SYMONS, *du Pont Experimental Station, Polychemicals Department, Wilmington, Delaware*

Evidence is presented showing that the phenomenon of polymer crystallization from solution is not limited to the relatively easily soluble polymers, such as polyethylene, nylons, and polyoxymethylene, but occurs also in the case of polytetrafluoroethylene. Although single crystals of this polymer have not been isolated thus far in the present work, well-defined dendrites, whose optical and x-ray properties indicate growth by a folded chain mechanism, are described.

Microscopical Studies of Fractionated Polyethylene

V. F. HOLLAND, *Chemstrand Research Center Corporation, Research Triangle Park, North Carolina*

Crystalline structures precipitated from dilute solutions of fractionated polyethylene have been examined microscopically. The morphology of these structures is presented and discussed in relation to temperature of crystallization and molecular weight.

The Microscopical Structure of Viscose Rayon

F. F. MOREHEAD, *American Viscose Corporation, Research & Development Division, Marcus Hook, Pennsylvania*

The microscopical investigation of viscose rayon has progressed from simple identification to an understanding of the relation of structure to manufacturing processes. The "skin effect," as revealed by staining, is a most useful tool. The "skin effect" is compared with results of phase and interference microscopy. Newer results obtained with the electron microscope are also shown.

Microscopical Studies of Polymerization Initiation

M. WISHMAN, F. E. DETORO, M. C. BOTTY, C. FELTON, and R. E. ANDERSON, *American Cyanamid Company, Research Laboratories, Stamford, Connecticut*

Both ultraviolet and electron microscopes were used in studying polymer formed at early stages of batch polymerization of acrylonitrile. The influences on the latex of adding 2-methyl-5-vinyl pyridine, and of total monomer concentration, were also examined. Interpretations of the microscopical observations are compared with chemical interpretations, while the academic and practical significance of the study is considered.

Microscopical Techniques for the Investigation of the Structure of Paper

CLINTON D. FELTON, MARTIN C. BOTTY, and JAMES J. CLARK, *American Cyanamid Company, Microscopical Group, Stamford, Connecticut*

A light microscopical technique involving partial embedding and metallizing of paper samples permits direct observation of the physical appearance and the interrelationships of the individual fibers. A new simplified one-step replica technique at room temperature allows detailed examination of the fine structure of the individual fibers. Both methods are rapid and reliable, and the results are easy to interpret.

Light Microscopy of Acrylic Fibers

KOICHI KATO, *Toyo Rayon Co., Ltd., Research Department, Otsu, Japan*

Three different kinds of light microscopical technique successfully applicable to acrylic fibers are described.

1. Phase contrast microscopy should be of special interest in respect to how the phase contrast picture may be correlated with the electron microscopical image.

2. The basic dye staining is a procedure not only useful in differentiating structural details of acrylic fibers but also indicative of the practical dyeing properties of the fiber under study.

3. Sandocryl dye staining is assumed to be due to the formation of a copper complex salt followed by the adsorption of the acidic dye involved. It is, therefore, a kind of chemical stain specific for acrylic fibers which may be used in both light and electron microscopies.

Representative results are demonstrated, to which some electron microscopical results obtained by means of ultramicrotome are added.

Yesterday, Today, and Tomorrow in Polymers

THEODORE G. ROCHOW, *American Cyanamid Company, Central Research Division, Stamford, Connecticut*

Twenty-five years ago industrial polymers were derived chiefly from natural or modified materials. Accordingly, the microscopist's role was chiefly to describe or identify morphology in kind or degree and sometimes to suggest processes or predict properties—all in a simple, linear relationship. Today we have a complex spiral of data, involving (1) the molecule of a certain size, configuration, and conformation, (2) association of compatible molecules, with or without man-made orientation, (3) inherent (crystalline) arrangements, and (4) polyphase systems. Tomorrow, if not today, the microscopist must coordinate patterns and spectra as well as pictures, and relate composition-decomposition to properties on specific levels. The high hope is that order is evolving from the explosion population of data.