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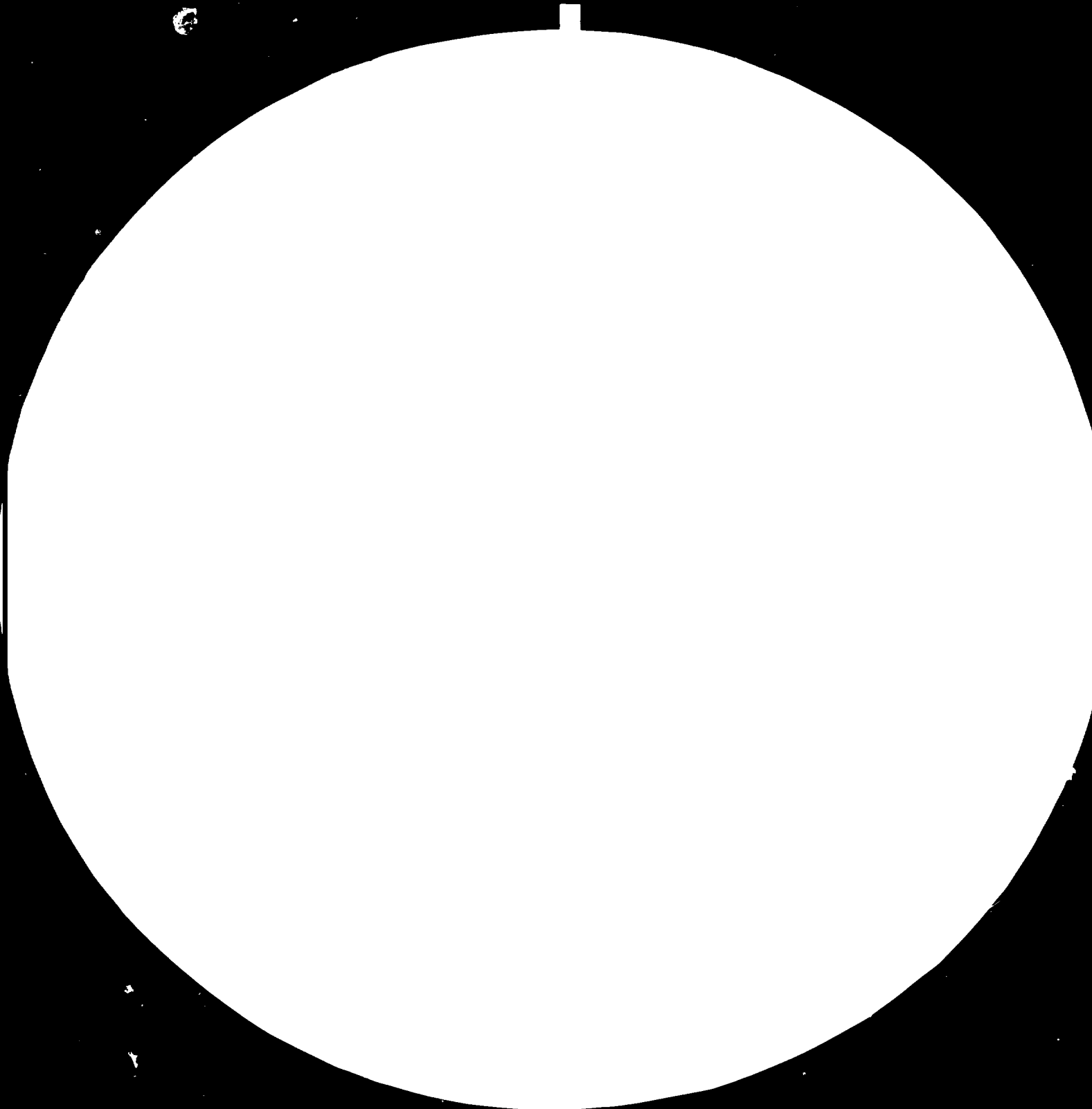

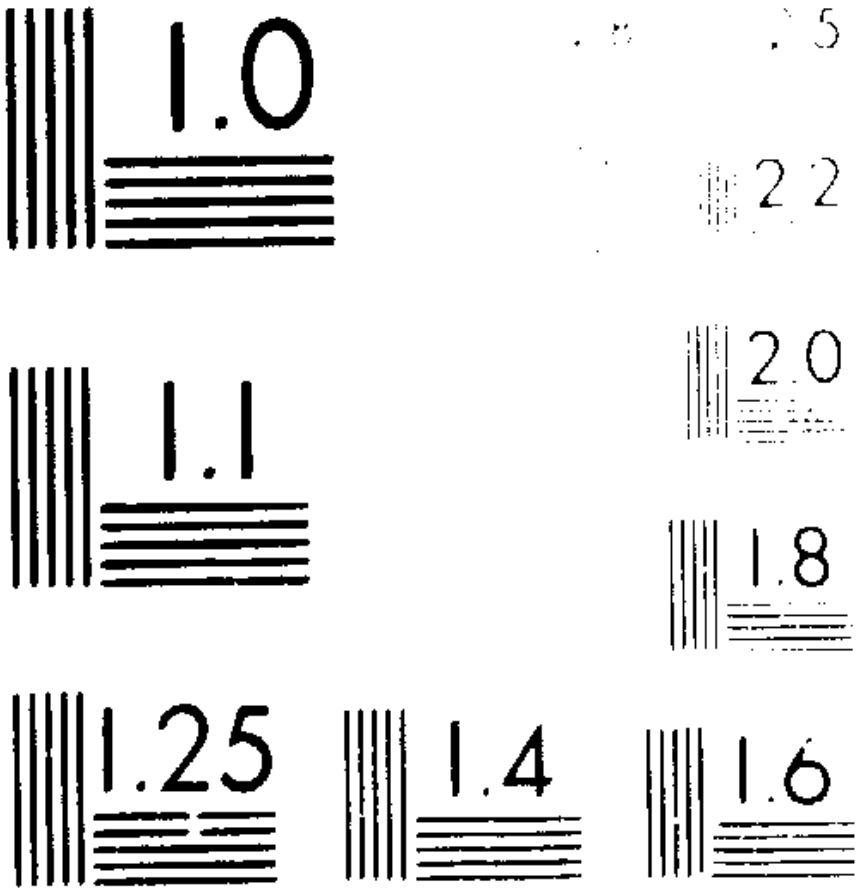
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MISSION TO

SHANGHAI DYESTUFFS CORPORATION,

SHANGHAI, CHINA.

Final Report

submitted

by

DR. F. JONES

Post: DP/CPR/80/061/11-02

Mission Duration: 1 September to 1 October 1982

Confidential

United Nations Industrial Development Organisation

Special Service Agreement

Expert on Mission Index No. E548461

PPRS/App/No. 286/82/JM

Final Report:- Visit to Shanghai Dyestuffs Corporation, Shanghai, China

Expert on Mission:- Dr. F. Jones

Duration of Mission:- 1st September to 1st October 1982

Dyestuffs Processing Post No. 11-01.

Programme

After briefing at UNDP Office, Beijing, 2-3rd September arrived Shanghai 4th September. Commenced duties at the Shanghai Dyestuffs Research Institute on the 6th September. This Institute was visited daily over the periods 6-11th, 13-17th and 20-24th September, all dates inclusive, from 8.30 a.m. - 16.30 p.m.

During these periods six lectures, duration 2.5 - 3.0 h. were given. All lectures were relevant to the list of topics presented previously to the Expert in DP/CPR/80/061 and no item on this list was rejected or found inappropriate. The lecture topics given were

1. Structural Aspects of Anionic Dye Solutions
2. Innovative Uses of Dyes
3. Thermal Analysis of Dyes and Pigments
4. Hot-stage Microscopy of Dye and Pigment Dispersions
5. Particle Size Assessment of Dye Dispersions
6. Reduction of Vat Dyes in Relation to Morphology and size.

In addition a colour videotape of two films made at Leeds University, Department of Colour Chemistry, under the direction of the Expert were shown at the Research Institute. These were "On the Plant" and "Idea to Reality" both instructional teaching films for use by undergraduate students of colour chemistry.

Other sessions were arranged for answering questions based on the lecture topics and further sessions for the discussion of specific problems encountered by the research workers during the course of their research.

In addition lecture No. 5 was repeated at the Shanghai Chemical Society headquarters and visits were made to a sericulture farm, Shanghai No. 1 Silk Mill, the Shanghai Research Institute for Arts and Crafts, and the East China Institute of Chemical Technology.

The period 25th-28th September was spent at the Dalian Institute of Chemical Technology where lectures Nos. 2 and 5 were given together with the above-mentioned video-recordings. Debriefing at UNDP office Beijing took place on Thursday 30th September.

Observations

1. Average attendance at each lecture and relevant question-answer sessions was 30-40 engineers and chemists drawn mainly from the Research Institute but including staff members invited from the East China Institute of Chemical Technology, Dalian Institute of Technology and Shenyang Dyestuffs Research Institute. The meeting at the Shanghai Chemical Society was attended by approx. 200 chemists and engineers drawn mainly from the production units of the Shanghai Dyestuffs Corporation.

   The question sessions showed that chemists had a detailed knowledge of individual processes or research topics with which they were directly concerned but a much more limited knowledge on wider fundamental issues. Questions generally reflected a lack of information on research published in other countries particularly over the 1960-1975 period. Information related to the physical principles of particle size assessments particularly when applied to pigments, paints and printing inks was even more lacking and the newer technology (1975-82) was virtually unknown.

2. Specific problems related to the current work of the Institute were discussed in some detail. These included the determination of the

proportion of metastable forms in Cu-phthalocyanine, disperse and vat dyes, the measurement of reduction rates of vat dye dispersions and the processing of dye powders to improve storage and dispersion stability, in addition to coupling methods to obtain azo dye solids of improved filtrable form. The expert was able to suggest several new approaches to these problems and was able to supervise the beginnings of some of these newer techniques. In view of the lack of current awareness however it was found generally that the researchers had not developed an enquiring critical faculty nor did they exhibit much originality in their thinking.

3. A close inspection of the laboratories at the Institute was carried out and the new building sited next to the Institute was visited twice. The current laboratories relevant to dyestuffs, finishing and application lacked a considerable amount of equipment. There was very little laboratory scale dyeing and dye finishing equipment for milling, separation processes, spray drying and drying. Particle sizing appeared to be carried out simply by optical microscopy coupled with the use of a Joyce-Loebl disc centrifuge. Coulter counters, scanning electron microscopy (S.E.M.) and laser light scattering techniques were not used. The application of X-ray diffractometry, S.E.M., thermal analysis and hot stage microscopy to specific problems could only be carried out by recourse to other research institutes which possessed the required instrumentation. This necessitated purchase time and a loss of control over precise conditions to which the sample had to be subjected. Thus some of the data on X-ray diffraction of pigments was of very poor quality with high (50-60%) background scatter which could have been eliminated by careful instrument control using a researcher familiar with the problem. The time factor involving delay in obtaining results in this fashion is also relevant. Pilot scale equipment for processing and dyeing trials was found to be limited. Experimental work at this level was conducted in full scale equipment

located in dyehouses and manufacturing units with consequent discouragement and shut down time for normal production.

In addition there was no evidence of technical data and dye specifications or processing instructions for dye application available in the laboratories. Such data, issued by dye and pigment manufacturers, usually in the form of pattern books and regularly up-dated, should be immediately available for rapid consultation by the chemist working on any related topic.

As far as the Expert could ascertain safety regulations were minimal. Protective clothing, disposable plastic gloves and eye shields or spectacles were not worn.

Great interest was shown by the Institute's staff and others in instrumental methods of determining median particle size and size distributions in dye and pigment solids. Technical specifications for laboratory instrumentation including scanning optical microscopy, Coulter counter instruments and Photon Correlation Spectroscopy were supplied by the Expert to individuals and a more complete list of instrumental recommendations is attached as Appendix 1.

Recommendations

1. Re-equipment of New Laboratories

a) The Xenotest fading lamp should be supplemented by two cheaper Microscal laboratory fading lamps. These will reproduce daylight fading conditions with a more intense light source and consequent rapid fading rates.

b) Purchase of a simple X-ray powder diffractometer with camera attachment and chart recorder output. A sophisticated 3-dimensional X-ray goniometer is not essential.

c) A thermal analyser operating in both differential thermal analysis and differential scanning calorimeter modes for the study of solid state phase changes in dyes and pigments is necessary. A thermal gravimetric

analysis attachment for recording weight losses would be an advantage but not essential. A microbalance capable for a ± 0.01 mg resolution is essential for quantitative D.S.C.

d) Visual observation of phase changes by the use of a hot stage microscope cell capable of operating up to 140°C for aqueous dispersions and 250°C for dry solids.

e) A scanning optical microscope would be of considerable use. This type of instrument is not as yet commercially available. It will deal with sub-micron sized dispersions without the necessity of observation in vacuum conditions and without prior coating of samples. Both these conditions are required for scanning electron microscopes. Failing the scanning optical microscope a scanning electron microscope of low to medium (max 10,000x) magnification power will be essential.

f) Milling equipment, ball and roller mills, for preparation of dispersions of dyes and pigments in addition to the sand mill already in use will be necessary. In finishing processes a laboratory scale spray-drier capable of producing dye in granular and encapsulated form in addition to dye powder is required.

g) Bench type (e.g. Rotadyer) laboratory dyeing machines are strongly recommended.

h) A small section dealing specifically with pigments for paints and printing inks, the preparation of drawdowns and a small scale rapid printing unit for test purposes should be an essential but longer term requirement.

2. Library Facilities

The establishment of a technical library stocked with modern technological text books (see Appendix 2), some current periodicals, the Colour Index (3rd Edition), manufacturers' pattern books and relevant sections of Chemical Abstracts, and a photocopier should be of high priority. The

library should be open to all researchers.

3. Safety Aspects

A safety officer, dealing with all safety matters e.g. protective clothing, gloves, eyeshields etc., toxic hazards of chemicals, safety of equipment (guards) and, where X-ray diffraction is used, the establishment of a safety film badge service for monitoring of X-ray exposure, fire risks, extinguishers etc. should be appointed.

Additional Comment

1. The importance of sample control during actual experimental measurements in e.g. X-ray diffraction has already been stressed. The integration of essential equipment in the Institute "under one roof" allows planning of experiments and the full utilisation of apparatus to be more readily achieved. This also applies to pilot-plant scale dyeing and dye manufacture equipment where, at present, researchers have to use large scale machinery situated at a distance from the Institute. The establishment of a pigments and paints testing section will become of greater importance in the future since the 12th Party Congress decision to continue upgrading Chinese technology will lead to a considerable demand to improve paint production and quality.

2. Some attempt should be made to improve direct communication not only between the various dye producing plants and the Institute but also between individual plants. The vat dye and the disperse dye plants e.g. rely on common anthraquinone intermediates. A common intermediates plant supplying both disperse and vat dye plants would be one suggestion. A second suggestion is that filtercake as produced by each dye plant could be processed into the finished form by a separate milling, spray drying, finishing and packaging unit.

3. The quality of research work and its successful application to commercial production of any research unit is ultimately dependent upon the educational standards of its employees, upon their critical thinking and their originality of approach to new problems. This applies equally to the Shanghai Dye Research Institute. Although not specifically within the remit of the Expert's mission, visits and discussions with staff at the East China Institute of Chemical Technology and the Dalian Institute of Technology (Colour Chemistry Departments) revealed a similar situation with respect to modern instrumentation and awareness. This was particularly applicable to undergraduate teaching. Since the research institute and manufacturing units draw heavily on these sources for scientific manpower it cannot be expected that the quality and practical ability of researchers will improve unless attention is paid to deficiencies in the teaching establishments. This would require co-operation between various Government Departments.

F. Jones

15 October 1982

Appendix 1.

Appendix 2.

Appendix 1.

Suppliers of technical information and laboratory scale instruments recommended in this report.

Instrument Type	Suppliers
Laboratory Ball and Bead Mills	1. Glen Creston Machinery Ltd. 16 Dalston Gardens Stanmore Middlesex, HA7 10A, U.K.
	2. Pascall Engineering Co. Ltd. Gatwick Road Crawley W. Sussex, RG10 2RS. U.K.
Laboratory Spray Driers	1. Büchi Laboratory-techniques Ltd. CH-9230 Flawil Switzerland.
Thermal Analysers DTA-DSC-TGA	1. Du Pont Inc. Export Sales Section Concord Plaza, McKean Building Wilmington Delaware, DE 19818, U.S.A.
	2. Instruments Division Perkin Elmer Corp. Norwalk Connecticut 06852, U.S.A.
	3. Stanton Redcroft Ltd. Copper Mill Lane London, SW17 OBN, U.K.
Particle Sizing < 5μ	1. Malvern Instruments Ltd. Spring Lane Malvern Worcester, U.K.
	2. Coulter Electronics Ltd. Northwell Drive Luton Beds., LU3 3RH
Image Analysis (counting)	1. Graphic Information Systems Ltd. High Street Blairgowrie Perthshire Scotland, U.K.

Appendix 1 (cont.)

Instrument Type	Suppliers
X-ray Powder Diffractometer	1. Siemens A.G. c/o Jebsen and Co. Ltd. Hong Kong 2. Pye Unicam Ltd. York St. Cambridge, CB1 2PX, U.K.
Scanning Optical Microscope	1. Drs. C.T.R. Sheppard and T. Wilson Oxford Opto-electronics University of Oxford Oxford, U.K.
Lab-scale Dyeing Equipment	
Colortec DK (HT) Hot stage microscope	Roaches Engineering Ltd. Upperhulme Leek Staffs, ST13 8TY, U.K.
Fastness testing (light)	Microscal Ltd. 79 Southern Row London, W10 5AL, U.K.
Dyeing Units	1. Platt-Longclose Crescent Works Dewsbury Road Leeds 11 W. Yorks, U.K. 2. Goodbrand-Jeffreys Elm Works Mere Lane Rochdale Lancs., OL11 3TE, U.K.

The above list is not comprehensive. Further information and specific requests can be obtained directly through the Expert on Mission.

F.J.

Appendix 2.

A List of Current Periodicals and Textbooks directly related to the production and properties of dye and pigment particulate material is given below. Textbooks are limited to those published after 1970 or to those published earlier but of specific interest.

Periodicals

Name	Publisher
1. Journal of the Society of Dyers and Colourists	Society of Dyers and Colourists, P.O. Box 244, Perkin House, Grattan Road, Bradford, BD1 2JB, U.K. (S.D.C.)
2. Colour Index Amendments and Additions	Society of Dyers and Colourists, P.O. Box 244, Perkin House, Grattan Road, Bradford, BD1 2JB, U.K. (S.D.C.)
3. Review of Progress in Coloration (annually)	Society of Dyers and Colourists, P.O. Box 244, Perkin House, Grattan Road, Bradford, BD1 2JB, U.K. (S.D.C.)
4. International Dyer	Industrial Press Ltd., 91 Kirkgate, Bradford, BD1 1TB, U.K.
5. J. of the Oil and Colour Chemists Association	Priory House, 967 Harrow Road, Wembley, Middlesex, HAO 2SF, U.K.
6. Dyes and Pigments	Applied Science Publishers, Ripple Road, Barking, Essex, U.K.
7. Textile Chemist and Colorist	A.A.T.C.C., P.O. Box 12215, Research Triangle Park, North Carolina 27709, U.S.A.
8. Amer. Dyestuff Reporter	S.A.F. International, 50 West 23rd St., New York, N.Y. 10010, U.S.A.
9. Textilveredlung	Postfach 2144, CH-4001, Basel, Switzerland.
10. Chemical Abstracts (Macromolecular Section)	American Chemical Society

Appendix 2 (cont.)

Textbooks

(a)	Reference Volumes	Publisher
1.	The Colour Index 3rd Edition	Society of Dyers and Colourists (as 1 above) (S.D.C.)
(b)	Dyeing Technology	
1.	Theory of Coloration of Textiles, Ed. C.L. Bird and W.S. Boston	Dyers' Company Publications Trust (S.D.C.) (1975)
2.	Dyeing of Synthetic Polymer and Acetate Fibres, Ed. D.M. Nunn	Dyers' Company Publications Trust (S.D.C.) (1979)
3.	Textile Printing, Ed. L.W.C. Miles	Dyers' Company Publications Trust (S.D.C.) (1981)
4.	Standard Methods for the Determination of Fastness, 4th Edition	S.D.C. (as 1 above) (1979)
5.	Dyeing Fibre Blends, R.C. Cheetham	Pub. Van Nostrand (1966)
6.	Physical Chemistry of Dye Adsorption, I.D. Rattee and M.M. Breuer	Academic Press, London (1974)
7.	A Laboratory Course in Dyeing, 2nd Edition, C.H. Giles	S.D.C. (as 1 above) (1971)
8.	Diffusion in Polymers, J. Crank and G.S. Park	Academic Press, London (1968)
9.	Diffusion and Sorption in Fibres and Films, R. McGregor	Academic Press, London (1974)
10.	Photochemistry of Dyed and Pigmented Polymers, N.S. Allen and J.F. McKellar	Applied Science Pub., London (1980)
(c)	Colour Chemistry	
1.	Fundamentals of the Chemistry and Application of Dyes, P. Rys and H. Zollinger	Wiley Interscience, London (1972)

Appendix 2 (cont.)

2. Colour Chemistry, R.L.M. Allen, Publ. Nelson, London (1971)

3. Dyes and their Intermediates, E.N. Abrahart, 2nd Edn. E. Arnold, London (1977)

4. Colour and Constitution of Organic Molecules, J. Griffiths Academic Press (1976)

5. Chemistry of Synthetic Dyes, Vols. I-VIII, K. Venkataraman (Ed.) Academic Press (1971)

6. Analytical Chemistry of Synthetic Dyes, K. Venkataraman (Ed.) J. Wiley & Sons, New York (1977)

7. Chemistry of Quinonoid Compounds, Parts 1 and 2, S. Patai (Ed.) J. Wiley & Sons, New York (1974)

8. Natural Colours for Food and Other Uses, J.N. Counsell Applied Science Publishers (1981)

9. Developments in Food Colours - 1, J. Walford Applied Science Publishers (1980)

(d) Solid State Particles

1. The Powder Method in X-ray Crystallography, L.V. Azaroff and M.J. Buerger McGraw Hill, New York (1958)

2. Granulation, P.J. Sherington and R. Oliver Publ. Heydon, London (1981)

3. Solubilization by Surface Active Agents, P.H. Elworthy et al. Chapman and Hall, London (1968)

4. Differential Thermal Analysis, Vol. 2, R.C. Mackenzie Academic Press (1972)

5. Particle Size Measurement, 2nd Edn., T. Allen Chapman and Hall, London (1975)

Appendix 2 (cont.)

6. Physics and Chemistry of the Organic Solid State, Vols. I-III, Eds. D. Fox, M.M. Labes and A. Weissberger — Interscience Publishers, N.Y. (1965)

7. Characterisation of Powder Surfaces, G.D. Parfitt and S.W. Sing — Academic Press (1976)

8. Particle Size Analysis, Ed. M.J. Groves — Heydon, London (1978)

9. Pigments - An Introduction to their Physical Chemistry, Ed. D. Patterson — Elsevier Pub. Co. (1967)

10. Dispersion of Powders in Liquids, G.D. Parfitt, 3rd Edn. — Applied Science Publishers, London (1981.

F.J.