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BRITISH SOCIETY OF SCIENTIFIC GLASSBLOWERS

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EDITORIAL

THE outstanding success of the Reading Symposium is very reassuring to the Society and demonstrates in no uncertain way the desire of its members to keep up to date with modern glass technology. It shows what good teamwork can achieve and one is bound to reflect that if the same energy and spirit is applied in other directions, there is no problem that cannot be solved. The Thames Valley organisers have gone a stage further than is usual for these meetings in obtaining most of the papers written up; which leaves the Journal with the problem of publication. This can be done in two ways, either producing a separate volume of the proceedings, which most will agree is the ideal method, or to spread over several issues of the Journal endeavouring at the same time not to alter its general character. The decision might have been easier had an increased annual subscription been agreed to at the Special General Meeting reported below, and one can only suggest that each member gives careful consideration to this question, so that when the subject is revived, as it surely will be, his Section representatives are able to give a true opinion so that Council are able to assess an acceptable increase.

Appeal

It is with regret that we must announce that Mr. D. A. Henson (Treasurer) and Mr. J. A. Frost (Advertising Manager) wish to retire from Journal work at the end of the year. Their recent efforts have considerably improved the financial side but the encroachment on free time is now too great. We trust that volunteers will come forward to take their place to avoid any interruption in the continuity of this Journal.

GENERAL MEETING — 8th SEPTEMBER, 1967

Annual subscriptions

AT 11 a.m. prior to the Symposium a Special General Meeting took place to consider a proposal that the annual subscription be increased from two to four guineas with an entrance fee of £1. Mr. E. G. Evans in the chair opened the meeting with a preliminary talk on the financing of the many activities of the Society, pointing out that the present tight budget would not allow for further development of schemes the Society would like to pursue and by the end of 1967, although we would not be in debt, there would be only a small surplus. The situation had been aggravated by the failure of a large number of members to renew their subscription, and taken in conjunction with a substantial reserve some two years ago, the hard fact is that expenditure now exceeds income. Our annual subscription is lower than any comparable Society.

Time was then allowed for discussion during which widely different views and suggestions were put forward, but the general trend was that the suggested increase was not acceptable. In the vote that followed a substantial majority (64 to 43) was against the increase and as no alternative proposal was on the agenda, an exploratory vote was taken on an increase to £3 3s. The indications were that this figure would have been accepted and the chairman stated that a further formal proposal will follow later.

A second proposition on the agenda, that the period of grace be reduced from six to three months, was carried by an almost unanimous vote. This will become effective from 1st January, 1968, and will be rigidly enforced.

The Journal is published quarterly by the B.S.S.G. and is available free to members and at 10s. 0d. per copy (or 35s. 0d. per annum) to non-members. A limited number of back copies are available. Editorial communications should be addressed to the Editor, c/o H. H. Wills Physics Laboratory, Royal Fort, Clifton, Bristol 8, and enquiries for advertising space to J. A. Frost, Chemistry Dept., University of Reading. Printed in Gt. Britain by E. G. Ellis & Sons, Willow Street, London, E.4.

Paper given at 1967 Symposium at Reading

RADIATION AND ITS EFFECTS ON THE TISSUES OF THE EYE

by D. F. ROUSELL, M.I.S.S.O., *British American Optical Co. Ltd.*

"The eye which is the window of the soul is the chief organ whereby the understanding can have the most complete and magnificent view of the infinite works of Nature." Leonardo da Vinci (1452-1519)

WHILE much has been written about inadequate illumination of our working areas, there is little information on the harmful effects of some kinds of light upon the eyes.

This discussion is an attempt to summarise the types of dangerous radiations to which the eyes of workers in various industries may be exposed. But before we can do this we must learn just a little Anatomy and Physiology of the eye, and some Physics. The Physics first:

electro-magnetic spectrum (Fig. 1). The length of the wave can be related to certain physical responses which we know as heat and light.

The electro-magnetic waves within this Spectrum in which we are interested are designated according to the wavelength. Most text books use the Angstrom unit of measurement, but sometimes the wave length is expressed in micro-millimetres or microns. The relationships are as follows:

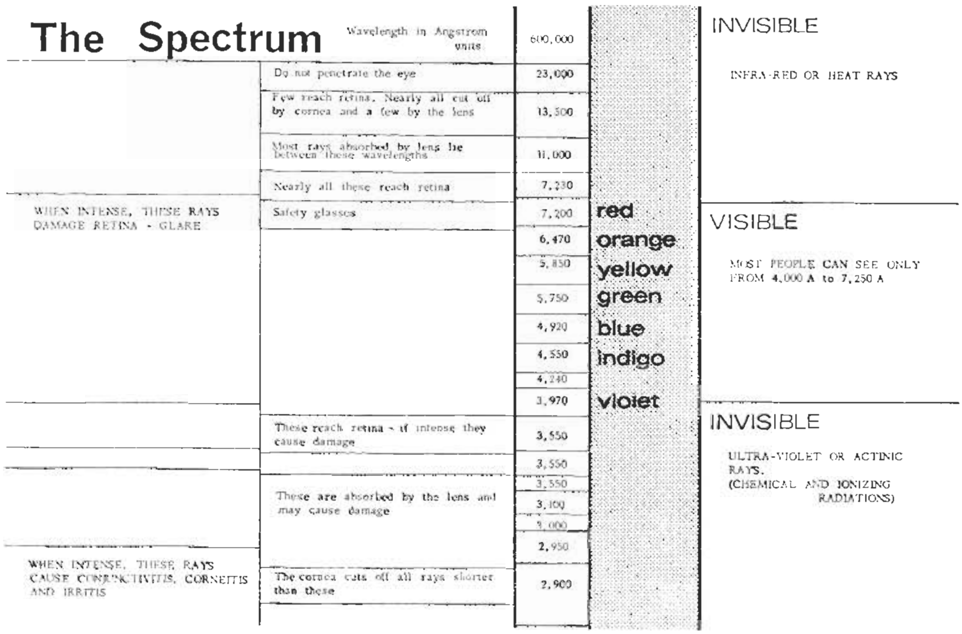


Fig. 1

Electro-magnetic Theory

This theory accounts for the phenomena of radio transmission and light in terms of electro-magnetic waves. The wave is a disturbance in space produced by the acceleration of an electric charge, and is comprised of an electric field at right-angles to a magnetic field, both moving at the same velocity. Plotting the waves, we get a picture of electrical activity which we call the

1 Angstrom unit $= 10^{-10}$ metre
10 ,, ,, = Micro-millimetre (mu) millionth part of millimetre)
10,000 ,, ,, = Micron (u) (one thousandth part of millimetre)

e.g. wavelength of sodium flame is 5,890 A° = 589 mu = 0·589 u = 0·000589 mm.

The electro-magnetic spectrum can be broken down into a number of component parts. It is important, however, to remember that each band of radiation cannot be separated too rigidly as the effects tend to merge gradually from one wave band to another.

(1) Infra-red radiation 600,000A°—7,250A° approximately. These wavelengths are invisible to the normal eye.

(2) Visible radiation 7,250A°—4,000A°. These give rise to light which we can see, or see objects by. The longer wavelengths are at the infra-red end and the shorter at the ultra-violet end. The intervening wavelength shade off through orange, yellow, green and blue.

(3) Ultra-violet radiation, approximately 4,000 A°—2,900A°. These, like the infra-red section, are invisible to the human eye.

(4) Ionising radiations. X-rays, gamma rays and cosmic rays.

It is important to remember that whatever wavelength we may be considering the nature of the radiation remains the same. All travel at 186,000 miles per second and all obey the law of inverse squares, namely, that the intensity varies inversely as the square of the distance. For example, if the intensity of light at a point one foot from a source is said to be one, the intensity at two feet is not half but $\frac{1}{2} \times \frac{1}{2}$ = one quarter. At four feet it is $\frac{1}{4} \times \frac{1}{4}$ = one sixteenth, etc. (Fig. 2).

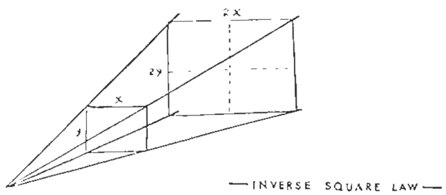


Fig. 2

The Eyes

The great physiologist Sir Charles Sherrington, wrote a classic description of the eye which I would recommend every person who is remotely responsible for eye care programmes to read. I have drawn on my memory of this work in writing the next few lines.

Most people draw an analogy to the camera when talking about the structure and function of the eye, and if asked to build a simple camera would take wood, metal and glass, and depending upon their ingenuity or acquired skills, could quite possibly make a unit with a variable lens position and apertures with a roll device for the film. However, if I said the materials were to be water, salt and albumen, you would say it is impossible; and yet that is what the whole of our body with all its complicated organs is evolved from.

The eye is a masterpiece of miniature photographic equipment, and is an integral part of the brain (Fig. 3). Through the nerve impulses stimulated by the light falling upon the retina, we obtain the sense of vertical, horizontal, square, round or contour: transparency, opacity, brightness, colour, near and distant. Acting upon this constant flow of information we are able to go about our daily business. The most sophisticated type of camera with accessories cannot compete with the human eye.

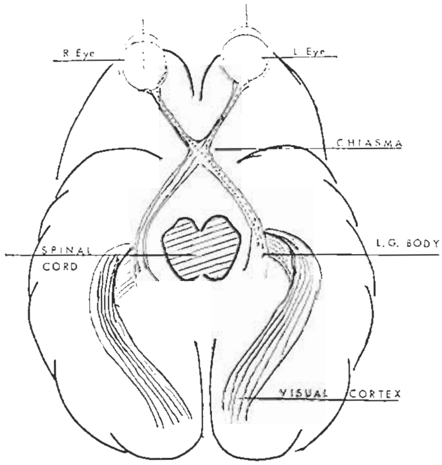


Fig. 3

Anatomy of the Eye

The eyeball rests within a bony cavity surrounded, except in front, by a layer of fibrous tissues and fatty tissues. If we remove the eyeball from the socket, strip away the protective tissues and the muscles which control its movements, we have a slightly elongated globe approximately 25 mm. in diameter.

Bisection of the globe in the vertical meridian (Fig. 4) shows that it consists of three concentric coats of tissue. The outer fibrous coat comprises the Sclera and Cornea ; the middle vascula coat comprises the Choroid, Cilary body and Iris; the inner layer of nervous tissue is the Retina. Behind the Iris lies the Lens; the space between the Cornea and the Iris is called the Anterior

Chamber and is filled with fluid; the large space behind the lens is called the Posterior Chamber and is also filled with fluid known as Vitreous humour.

The Sclera is a tough white fibrous tissue which surrounds five-sixths of the globe and is continuous with the cornea. Posteriorly there is an opening through which pass the optic nerves, arteries and veins.

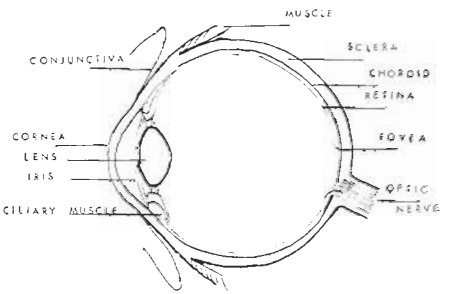


Fig. 4

The Cornea is a clear transparent tissue similar in shape to a watch glass approximately 11 mm. in diameter and 0·75 mm. thick. The Iris is a thin circular disc of muscle lying in close proximity to the lens, and the whole centre aperture is called the Pupil. The size of the pupil varies according to the amount of light present, from about 1·0 mm. to 4·0 mm. in diameter.

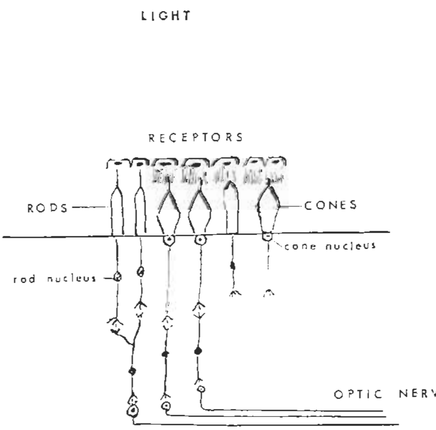


Fig. 5

The Lens is transparent and biconvex, approximately 10 mm. in diameter and 5 mm. thick at the centre. The fibres of tissue forming the lens are bounded by a transparent elastic membrane to which suspensory ligaments extend outwards to the Ciliary muscles. Movement of the Ciliary muscles control the lens shape and size necessary to focus the images upon the retina.

The Retina is the layer of nervous tissue lining the inner surface of the globe. It consists in fact of a number of layers. The light sensitive layer consists of cylindrical and conical processes known as rods and cones respectively (Fig. 5). When the retina is stimulated by light, nerve impulses are conveyed through a system of relays back along the optic path to the brain, where the final act of perception is performed.

Physiological Hazards

Electric charges, of which light is composed, act upon the cells forming the various tissues of the eye. As a result of this electric bombardment the structure of the cells is altered and the functions of the tissues disarranged.

The damage caused to the tissues in this manner is not so obviously immediate or dramatic as the destruction produced by direct heat or splashes from chemical substances. The effects of these radiations do not usually appear until some six to twelve hours after exposure. Physical changes in the appearance of the tissues, particularly the lens, appear months later, or more accurately, attract the attention of the patient many months later.

The Cornea, the Lens and Vitreous body, each have a selective power of absorption. The Cornea and the Lens effectively retain the ultra-violet radiations. The structure of the eye as a whole absorbs the entire infra-red radiations up to 15,000 A°, and about 94% of the visible light passes through the body of the eye and reaches the retina.

The infra-red radiation of the tissues is analagous to a pin-point burn upon the skin obtained by focussing the rays of the sun through a magnifying glass, with subsequent blistering and development of scar tissue.

The effects of ultra-violet radiation are well known to all of us who have at some time over-exposed our bodies to the sun. Normal healthy skin does, however, increase the keratin within its tissues, thus increasing the protection from subsequent exposures. The eye does not possess this protective chemical process and the burns produced by the ultra-violet rays are extremely deep seated and dangerous. The effects of ultra-violet radiation depend upon the intensity of the source, the length of exposure and are cumulative. The ultra-violet and infra-red radiations will be present to a greater or lesser degree in virtually any intense artificial light source, e.g. oxy-acetylene or electric-arc welding, molten metals and furnaces. The overall glare from such sources cause visual reactions.

Light-stroke or Dazzle

The brightness of the light source causes an immediate state of "dazzle" followed by a partial loss of vision, often described as veiling or fogging. Some four to six hours later the patient complains of "gritty eyelids," the membranes of the eyeball and eyelid are red and puffy, and tears flow. The eyelashes become clogged with a mucous secretion and light causes the patient further discomfort, the foggy and hazy vision remain. These conditions usually clear within 24 to 36 hours.

Electric-arc Stroke

This is better known to welders as "arc-eye" and can still be seen in its milder forms. The symptoms appear some six to twelve hours after exposure to intense sources of light of short duration (flashes). Sensations of having grit under the eyelids, accompanied by pain, marks the onset of the reaction. Slight redness of the eyes and sensitivity to light are present. In severe cases there are muscular spasms of the eyelids when trying to open them, inflammation of the tissues and sensitivity to light are greater, and are usually accompanied by headaches and sleeplessness.

Glass Workers Cataract

In the past, cataract of the lens among glass-workers was attributed to the immediate intense heat and the high ultra-violet radiation which existed when the glassblower used to dip his blowpipe into the molten glass and blow it to the required form, working between mould and flame.

Increased use of mechanical handling and the use of protective goggles has led to a decline in cataracts occurring in glassworkers today, although workers of near retiring age show some slight clouding of the lens.

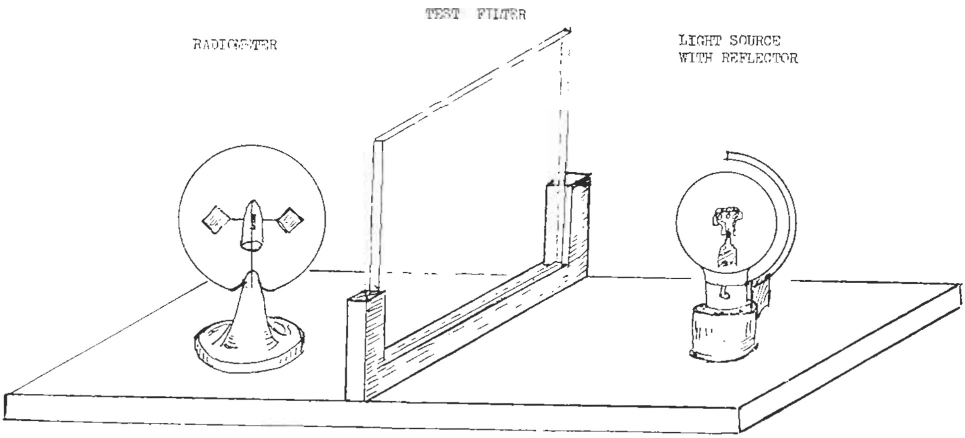
Protection

In my experience, the penalty of failing to wear the protective equipment provided is not easily and quickly demonstrated to the would-be user and the tendency is to discard the equipment, causing many safety programmes, particularly eye-care programmes to fall down. The protection afforded by genuine protective filters, for which transmission curves are given, can be easily demonstrated by using a radiometer for infra-red sources, and ultra-violet sensitive paper for ultra-violet sources (Appendix A).

B.S. 679 Protective Filters

These filters are used for welding and other industrial operations and are manufactured by Chance Brothers Ltd. They are obtainable from all safety equipment manufacturers or suppliers. There are 14 densities, the lightest shade designated is 3 GW1 (gas welding), the darkest 16 EW (electric welding) (Appendix B). They are available in the following standard sizes: 2 in. diameter discs, $4\frac{1}{2}$ in. × $3\frac{1}{4}$ in. and $4\frac{1}{2}$ in. × 2 in. rectangles.

APPENDIX A



DEVICE FOR TESTING PROTECTIVE FILTER FOR INFRA-RED

The B.S. 679 range of filters meet most of the glare, ultra-violet and infra-red hazards encountered and can be fitted to a wide range of helmets, goggles and spectacles. Large sheets for use in welding booths and on automatic welding and cutting equipment can be obtained to special order.

A disadvantage that may be encountered with this range is their colour. While the density of a particular filter may be ideal for the job in hand, the colour may be such that it affects the user's visual interpretation of the job, and some other filter may be necessary.

Ophthalmic Optical Tints

I use this title for lack of a better description, for a range of protective filters manufactured for the ophthalmic industry and prescribed by opticians where there is a clinical requirement. This range of filters is available from a number of suppliers of protective equipment. Unfortunately they cannot be obtained in the sheet form suitable for welders' helmets, but can be fitted to a very wide range of goggles and spectacles. They offer protection from ultra-violet and infra-red sources, and some have selective absorption of wavelengths between these two (Appendix C).

Special Filters

Within this group I have put Didymium glass for glassworkers, vacuum coated lenses and laser glasses.

APPENDIX B

B.S. 679 : 1959 FILTERS

Table 3
Recommended Filters for Gas Welding

Welding process	*Filters required for:* *Welding without flux*	*Filters required for:* *Welding with flux*
Gas welding of aluminium and aluminium magnesium alloys: lead welding or oxy-acetylene cutting	3/GW	3/GWF
Oxygen machine and hand-cutting Oxygen gouging Flame de-scaling Silver soldering Fusion welding of zinc base die castings Bronze welding of light gauge copper pipe and light gauge steel sheet	4/GW	4/GWF
Fusion welding of copper and copper alloys Fusion welding of nickel and nickel alloys Fusion welding of steel plate All bronze welds in heavy gauge steel and cast iron, except pre-heated work Re-building work of relatively small steel parts and areas for fusion welding All hard surfacing operations, including rail re-surfacing	5/GW	5/GWF
Fusion welding of heavy steel Fusion welding of heavy cast iron Fusion welding and bronze welding of pre-heated cast iron and steel castings Re-building large steel areas, e.g. large cams, etc.	6/GW	6/GWF

There are various operations, other than welding, in which the worker may be exposed to harmful radiation and in some cases unscreened radiation from other sources.

Table 4
Recommended Filters for Electric Welding

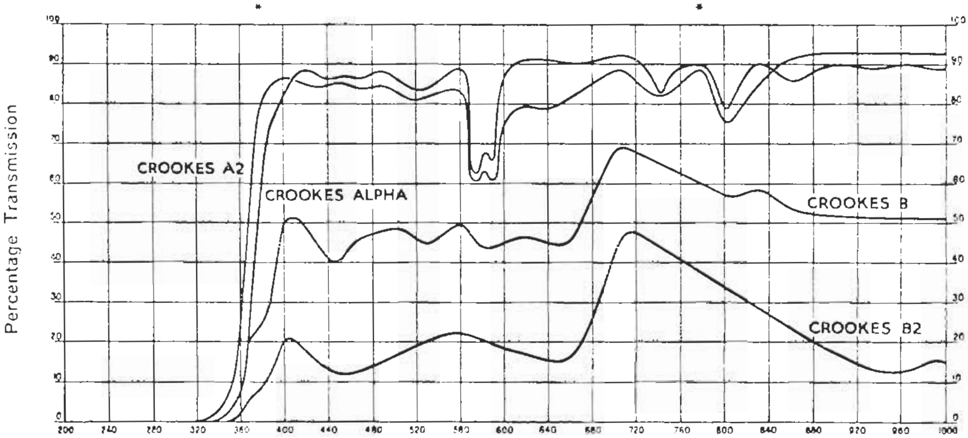
Welding process	*Approximate range of welding current (in amps)*	*Filter(s) required*
Metal-arc welding (coated electrodes) Continuous covered-electrode welding Carbon dioxide shielded continuous covered-electrode welding	Up to 100	8/EW 9/EW
	100-300	10/EW 11/EW
	Over 300	12/EW 13/EW 14/EW
Metal-arc welding (bare wire) Carbon-arc welding Inert-gas metal-arc welding Atomic hydrogen welding	Up to 200	10/EW 11/EW
	Over 200	12/EW 13/EW 14/EW
Automatic carbon dioxide shielded metal-arc welding (bare wire)	Over 500	15/EW 16/EW
Inert-gas tungsten-arc welding	Up to 15	8/EW
	15-75	9/EW
	75-100	10/EW
	100-200	11/EW
	200-250	12/EW
	250-300	13/EW 14/EW

Where two or more shade numbers are recommended for a particular process and current range, the higher shade numbers should be used for welding in dark surroundings and the lower shade numbers for welding in bright daylight out of doors.

Didymium. This filter (Appendix D) is used almost exclusively by the glassworking industry. It is expensive, but it does absorb almost 100% of the 589·0-589·7 Mu which give rise to the intense yellow or sodium glare encountered. It also has good absorption factors for iron and calcium (527·0 Mu) and oxygen (759·0 Mu). The major disadvantage of this material is that it is brittle, which causes a high breakage factor when being "worked," particularly in corrective lenses. Therefore many ophthalmic prescription laboratories refuse to handle orders for corrective spectacles unless the client is prepared to pay whatever price the finished product costs, which may be between five and ten pounds.

Vacuum-coated lenses have developed rapidly since the earlier work of "bloomed" instrument and camera lenses, and they are available under a wide range of trade names. The advantage of vacuum-coated lenses to the safety equipment manufacturers and users lies in the fact that optical glass, both white and tinted, can be coated

APPENDIX C

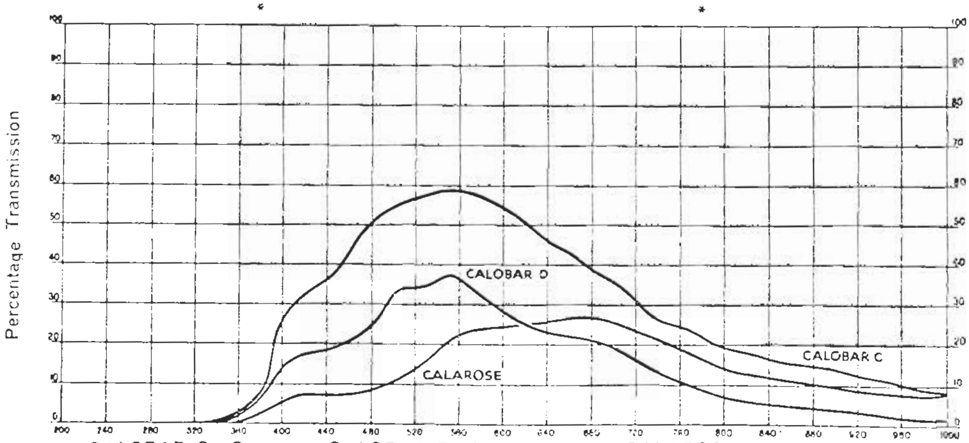


CROOKES ALPHA Very Pale Blue
Approx. IVT 82%

CROOKES A2 Pale Blue
Approx. IVT 72%

CROOKES B1 Greenish Smoke
Approx. IVT 47%

CROOKES B2 Deep Greenish Smoke
Approx. IVT 20%



CALOBAR C Green
Approx. IVT 51%

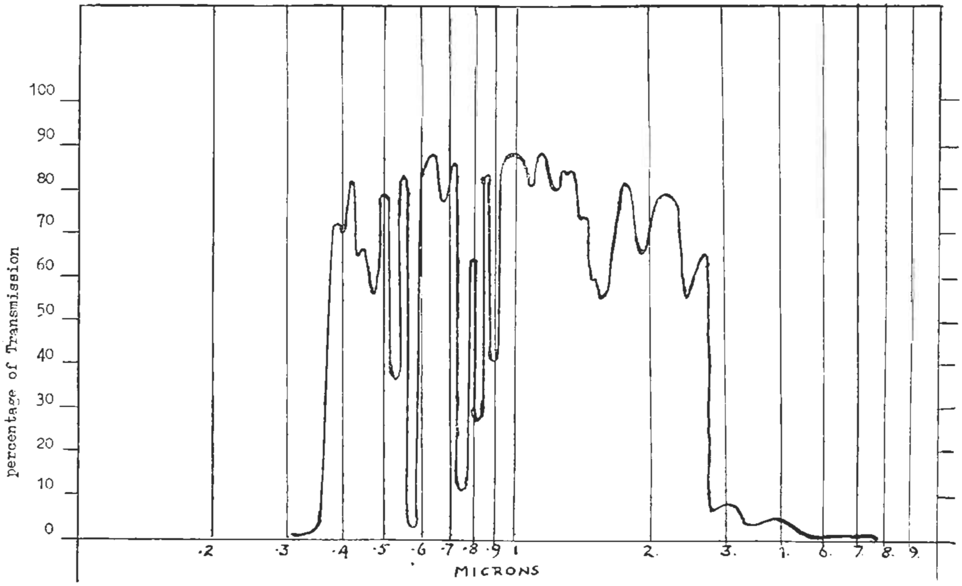
CALOBAR D Deep Green
Approx. IVT 36%

CALAROSE Deep Rose Smoke
Approx. IVT 21%

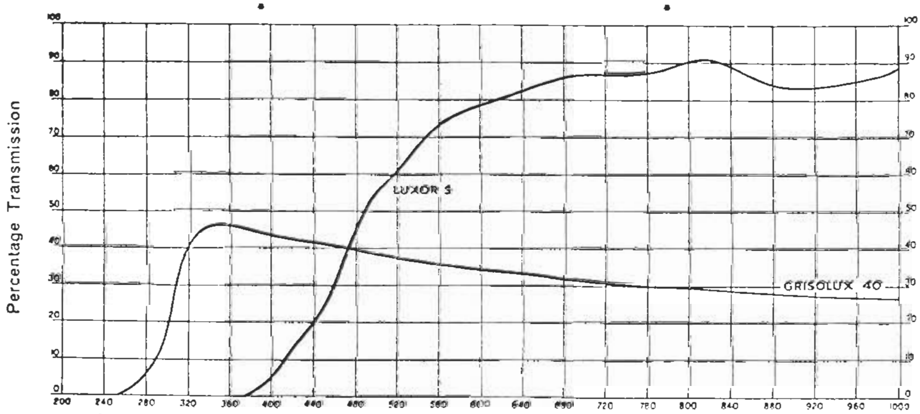
with various mixtures of metallic oxides and silicates to give tints of green, brown and yellow, of easily controllable density to meet the user's special needs (Appendix E).

Laser filters. This is an entirely new range of filters, each has been developed to give protection from lasers operating at a specified wavelength, and to withstand the thermal shock which the filter would be subjected to should it come within the beam path. It may be that scientific glass manufacturers will at some not too distant date see a practical application of the laser as a tool of production. If this proves to be so, great care will be required to protect the operatives from the laser radiation reflected from the working surface.

APPENDIX D
DIDYMIUM



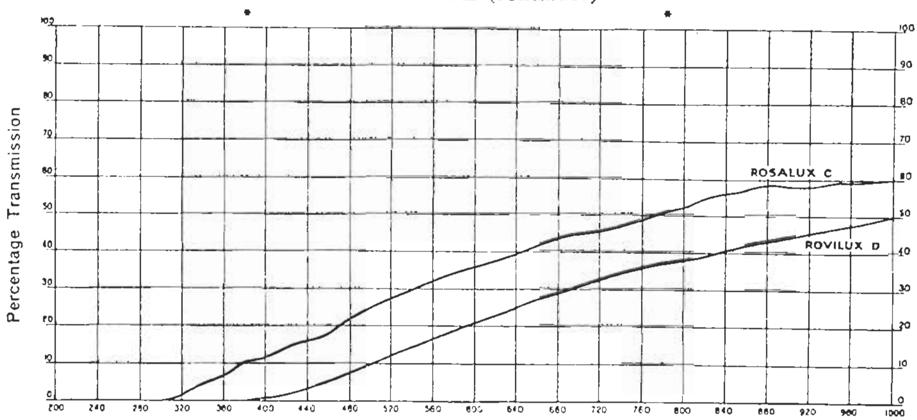
APPENDIX E
VACUUM COATED LENSES



LUXOR S Yellow
Approx. IVT 70%

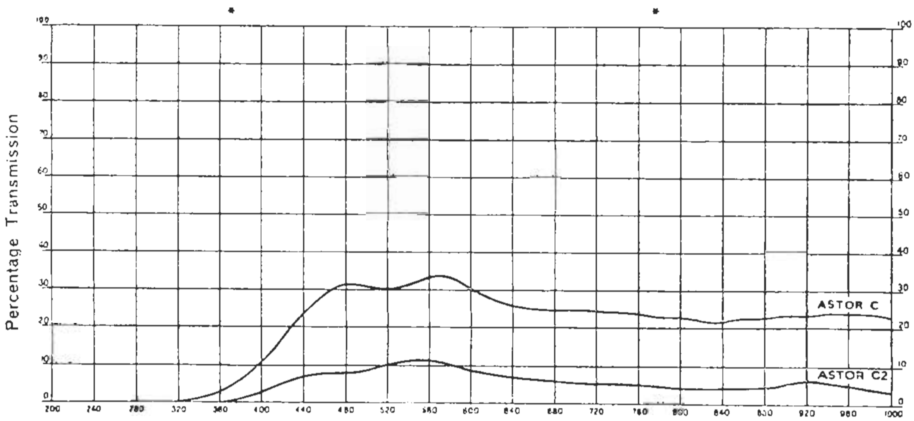
GRISOLUX 40
Approx. IVT 40%

APPENDIX E (continued)



ROSALUX C Medium Brown
Approx. IVT 30%

ROVILUX D Deep Brown
Approx. IVT 18%



ASTOR C Medium Green
Approx. IVT 30%

ASTOR C2 Deep Green
Approx. IVT 9%

Please note that on all charts the vertical scale indicates " Percentage Transmission " and the horizontal scale " Wavelength in Millimicrons."

* Denotes approximate limits of visible spectrum

In conclusion

For some years I have been advocating the teaching of basic anatomy, physiology and physics to all those in industry who are responsible for the safety, health and welfare of workers. I consider the anatomy and physiology of Hearing, Seeing and Respiration of particular importance, since these three faculties can be seriously damaged by physical forces which we may not See, Hear, Smell or Touch, emanating from a variety of common and specialised industrial processes. I believe that, with a basic knowledge of these subjects, you are well equipped to anticipate where a hazard may exist and understand why it is a hazard.

I hope that this discussion upon the anatomy of the eye and the physiological hazards of the unseen radiations from the electro-magnetic spectrum proves this belief.

THERMOMETERS

Lecture given to The British Society of Scientific Glassblowers
by D. DENTON *and* D. MARSHALL *of G. H. Zeal Ltd.*

Gentlemen

This evening my colleague Mr. Marshall and I will endeavour, with the aid of colour slides, to give you a brief insight into the history, development and production of thermometers.

History

Firstly a brief word on the two different scales for temperature measurement in use at present namely FAHRENHEIT and CENTIGRADE.

Thermometers, or thermoscopes as they were first called, came to light as early as 1592 when Galileo wrote of these and other scientific discoveries he had made. These early instruments were very crude affairs by today's standards, being filled with either water, wine or alcohol as a filling for registering temperature changes. Daniel Gabriel Fahrenheit was the first man to be accredited with the substitution of alcohol by mercury in 1714 during which time many notable men of science contributed to the development of the thermometer, among them being such people as Sanctorious, Bianconi, Ferdinand II, Grand Duke of Tuscany, Boyle, Huygens, Fabri, Dalence, Sir Isaac Newton and many others.

Fahrenheit was the first person to introduce the cylinder bulb as opposed to the spherical or round bulb hitherto used, because he could see the advantages of greater sensitivity through the increased surface area exposed ; even now some 250 years later, round bulbs are used only for air temperature work where speed of recording is not so important.

In 1742 the Swedish scientist Celcius took the two extreme points of freezing and boiling water as 0 and 100 which gave rise to the present centigrade scale.

Present day permutations of the various types of thermometers are enormous, they range from the standard clinical thermometer, approximately 4in. long with a range of 95-110° F to the 8ft. wine vat or tar boiler thermometers covering ranges of temperature from 200-600° F. The range which liquid in glass thermometers are capable of covering is from minus 200° C when filled with a special liquid called Pentane, or Mercury filled instruments made of high melting point glasses such as borosilicate or quartz to reach temperatures of 550° or 630° C.

Among the many trades, industries and commercial undertakings which use thermometers are those in refrigeration, horticulture, heating, ventilation, food production, explosives, chemical plant, oil refineries, laboratories, meteorological weather stations, sweets and candies, electrical engineering, diesel engines, dyestuffs, cotton mills, jute mills, fruit preserving and many others. In short there is hardly a trade that does not use a thermometer of one kind or another.

Production

Thermometer tubing is brought from the glass-house in cane form of approximately 5ft. lengths, roughly graded for diameter and type of capillary bore. From this grading, according to the specification for the type of instruments required for production, the glass is selected for correct bore size and diameter together with the elimination of certain physical defects such as stones or seed in the glass together with unwanted false bores. The glass is then cut to the length required and the bore is measured by binocular microscope to 0.01 of a millimetre, averaging the major and minor axis of the bore.

Having determined the exact potential of each piece of material, the glass stem is paired off with a suitable piece of normal glass cylinder, from which the mercury reservoir is formed. Normal glass is a term used to describe a type of glass which is thermometrically stable and approved by the National Physical Laboratory and other national scientific bodies for use as bulb glass.

This is an important feature of thermometer production as it has been found that certain glasses lose their stability during their working life and are unable to reproduce temperatures accurately due to a physical change such as shrinking during the ageing of the glass. It was the practice in the past for a special stock room to be made for holding all clinical thermometers for a period of two years before calibration and engraving to ensure that any physical changes had taken place prior to completion.

In these days of highly specialised scientific technology and all its applications in industry, accuracy of temperature measurement and recordings to a fine degree are demanded.

It is considered usual practice for the incorporation of an artificial ageing heat treatment process during which all thermometers are stabilised.

Returning now to the making of thermometers, the normal cylinder glass is joined to the stem by using a " needle point " flame, which fuses

ABSTRACTS

Compiled by S. D. Fussey

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(436) **A New Short Path Distillation Apparatus.**
Harry Morrison, *Jour. Chem. Educ.*, 44, 3, 161, March 1967.
Description of apparatus for the distillation of small amounts of materials, especially high boiling mixtures. F.G.P.

DENSITY

(437) **An Apparatus for the Determination of the Apparent Densities of Lump Solids at Elevated Temperatures.**
B. A. Napier and D. H. T. Spencer, *Jour. Sci. Instru.*, 44, 7, 568, July 1967.
Full description of glass apparatus for use at temperatures up to 740°C. Drawing. D.A.H.

GAS—CONTROL

(438) **An Automatic Töepler Pump using a Photoelectric Device.**
D. A. Price and J. Roach, *Jour. Sci. Instru.*, 44, 6, 473, July 1967.
The conventional three tungsten electrodes are replaced by two photoelectric cells. This enables the pump to be used for gaseous mixtures where electrical sparking would prove a hazard. Drawings. D.A.H.

(439) **Microvolumetric Measurements with an Automatic Töepler Pump.**
Russel N. Dietz, *Rev. Sci. Instru.*, 38, 3, 419-421, March 1967.
An improved design of a completely automatic Töepler pump with no contact between grease and mercury. Complicated grease-free valves are not required. Scale drawing of system. S.D.F.

GAS—LAWS

(440) **An Experimental Approach to the Ideal Gas Law.**
W. G. Breck and F. W. Holmes, *Jour. Chem. Educ.*, 44, 5, 293, May 1967.
Simple apparatus consisting of a thermometer, length of capillary tube and a test tube jacket to demonstrate the Charles' Law Effect. F.G.P.

GAS—PURIFICATION

(441) **Equipment for Building Gas Washing Bottles.**
W. Gödicke, *Lab. Pract.*, 16, 4, 484, April 1967.
Describes a set of parts for the construction of gas purifiers including dessicators which can be assembled as standard sets for all types of process. Obviates the use of trains of gas wash bottles and as cones and sockets are used to make the assemblies, vertical construction is possible. Sketches and various component combinations. B.R.W.

(442) **A Practical Method of Removing Oxygen from Inert Gases.**
A. D. Broadbent, *Jour. Chem. Educ.*, 44, 3, 145, March 1967.
A simple and efficient method of supplying oxygen-free inert gas for investigation of solutions of compounds sensitive to aerobic oxidation. Diagram. F.G.P.

GLASS—DECORATING

(443) **An Artist in Glass.**
Ronald Sharp, *Indust. Diamond Rev.*, 27, 319, 258, June 1967.
A schoolmaster finds pleasure and profit in glass engraving. His only tool a diamond pencil. W.V.B.

GLASS—JOINTS

(444) **An Improved Conical Glass Joint.**
G. P. Helliwell, *Lab. Pract.*, 16, 4, 495, April 1967.
Advantages over conventional ground joints are given together with test tables and precautions to be taken during lamp-working. B.R.W.

(445) **A Laboratory Method for Teflon to Glass Connections.**
M. Krulfield, *Jour. Chem. Educ.*, 44, 5, 303, May 1967.
A sleeve of Tygon or other material is slipped over the join to seal any gap left where rigid Teflon meets glass. F.G.P.

GLASS—SURFACE ATTACK

Alkali Attack of Glass Surfaces by Molten Salts.
R. F. Bartholomew and T. R. Kozlowski, *Jour. Amer. Ceram. Soc.*, 50, 2, 108, Feb. 1967.
An investigation of the surface reaction between molten sodium hydroxide and potassium hydroxide with soda-lime-silica, borosilicate, sodium-zirconia-silica and soda-alumina-silica glasses at temperatures of 350°C and 425°C. Photographs. D.A.H.

LIQUIDS—MEASURING

(447) **An Automatic Dosing Apparatus made with Standard Laboratory Ware.**
G. T. C. Stark, *Lab. Pract.*, 16, 5, 594, May 1967.
A robust apparatus consisting of a two litre aspirator, syphon, float assembly and hypodermic syringe. A test on the dosing syringe over twenty observations had a standard deviation of $\pm$ 0.023 m.l. about a mean value of 5.25 m.l. Labelled sketch and references. B.R.W.

SAFETY

(448) **Safety in the Chemical Laboratory.**
N. V. Steere, *Jour. Chem. Educ.*, 44, 5, 261, May 1967.
Review of an omnibus edition of articles on safety that have been published in this journal since 1964. Subjects covered are toxic fumes, fire hazards, lasers, biological contamination, laboratory design and many other safety factors. F.G.P.

(448A) **The Scope of Eye Protection in Industry.**
Anon, *Manufacturing Optician Intern.*, 20, 1, 6-9, July 1967.
Suggestions for modes of eye protection for use in various industries and laboratories. S.D.F.

SEALS, CERAMIC—GLASS

(449) **Sealing Alumina and Mullite to Hard Glasses.**
J. E. Benbenek, C. F. Stockdale and C. Yost, *Fusion*, 14, 2, 9-14, May 1967.
Full description of technique for making seals up to 3 inches diameter together with tables of properties of suitable glasses, alumina and mullite. S.D.F.

SILICA

(450) **Reaction between Vitreous Silica and Molten Aluminium.**
A. E. Standage and M. S. Gani, *Jour. Amer. Ceram. Soc.*, 50, 2, 101, Feb. 1967.
Vitreous silica rods were exposed to molten aluminium and the rate and depth of penetration was measured over a range of temperatures. Photographs and graphs. D.A.H.

SOLDERING

(451) **The Scientific Approach to Laboratory Soldering.**
Anon, *Lab. Equip. Digest*, 5, 7, 60, July 1967.
Discussion on the advantages of the soldered joint, suitable bits, optimum heat and the technique of making a joint. B.R.W.

STIRRERS

(452) **A Sealed Stirring Mechanism.**
O. Hello, *Jour. Chem. Educ.*, 44, 1, 35, Jan. 1967.
Diagram and description of a stirring device with a leakproof seal for enclosed chemical reactions. F.G.P.

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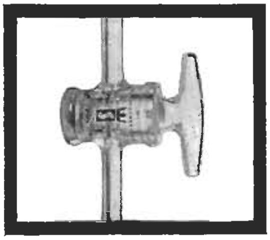

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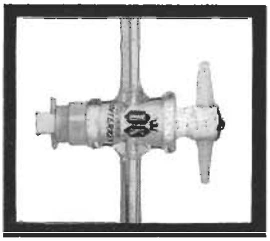

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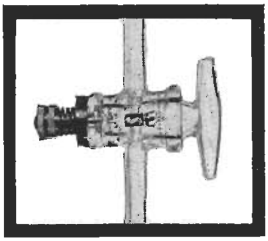

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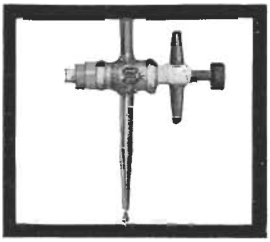

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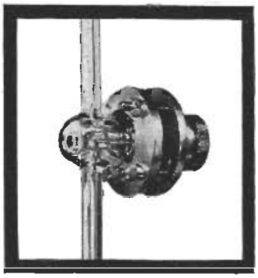

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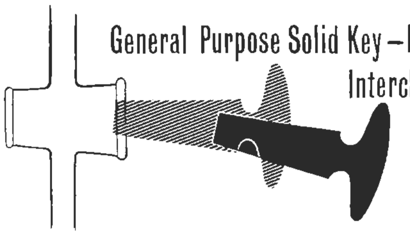

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together the open ends of the cylinder and the bore of the stem glass which has been enlarged by an earlier process called "chambering." The cylindrical bulb is then sealed off to a predetermined length.

When the bulb has been joined to the stem, the thermometers are placed in an annealing oven. The temperature is raised to the appropriate level for the type of material being used, i.e. lead glass approximately 480°C, normal glass approximately 520°C, borosilicate glass approximately 600°C. This essential process removes any strain which may have been put into the material during the glassblowing processes.

Having annealed the thermometer tubes they are inverted in a bell jar and the air inside the jar and the thermometers is completely evacuated by means of a vacuum pump. The mercury or spirit filling, whichever is required, is introduced into the bell jar so as to cover the open ends of the inverted thermometer tubes. Air is then let into the bell jar so as to break the vacuum whereupon the equalisation of pressure forces the filling medium to enter the bulbs. Having been filled the instruments are partially immersed, bulb end first, into tanks of liquids at regulated temperatures. Firstly, the excess mercury or spirit is brushed off at the top open ends of the thermometers, which are then placed in a second tank of liquid regulated at the temperature required and the bottom temperature point marked on the glass at the position where the mercury column registers. This denotes, therefore, the potential or scope of the temperature range and is a process called "scaling."

So far as mercury filled thermometers are concerned the next stage is to seal off the open end of the tubes and while the glass is still molten to warm the bulb end of the glass thermomter in a flame, causing the mercury to run up the bore which fumes on contact with the hot glass and causing the molten glass section to expand into a large elongated bubble. which becomes vacuous when the glass cools. Into this vacuous space bubble is thrown the mercury surplus to the requirements when the thermometer has been adjusted so that the range required is correctly positioned on the instrument. The method used for determining how much of this mercury is surplus to requirements, is to place the instruments in another temperature at a central position on the scale, at which point the mercury column is parted off, the surplus being removed as described previously.

To keep the mercury in a dry, atmosphere free condition, the vacuous space above the mercury column is filled with an inert gas such as nitrogen. This is done by pulling out a fine spill of glass at the top end of the glass thermometer, which has the bore running through it. This fine spill is broken under a nitrogen gas flow, the gas being sucked in by the vacuous condition of the instrument.

The last process on the glassblowing side of manufacture is to re-seal the open end of the glass causing a bubble to form at the top of the bore. This bubble or expansion chamber is provided to enable the mercury to be collected should at any time it become parted through bad handling or careless use. It also serves as a relief valve to control the pressure developed when the thermometer is working around the top temperature point.

At this stage the glass thermometers are carefully inspected and any scratches acquired during processing are polished out on a buffing wheel.

Calibration

When all the glassblowing processes have been completed the glass thermometers are prepared for engraving. This is done by making a permanent mark on the glass tube with a tungsten knife whilst the thermometer is immersed in a temperature regulated bath and using an N.P.L. tested standard thermometer for "pointing" the glass thermometers being produced. From these "point" marks are taken the settings for the machines which graduate the thermometers concerned though before any form of engraving can take place the thermometers are dipped in wax which completely covers the glass. The tubes are then placed on a graduating machine and a steel needle cuts the divisions into the wax, exposing the glass. Other types of machines are used for marking the figures and any other information required on the thermometers. The wax covered thermometer is then placed in a bath of hydroflouric acid which attacks the exposed glass in the wax. After a period of time the thermometers are removed from the acid, which is then neutralised and the wax removed in a degreasing plant. Then the etched graduation marks are filled with a black or other coloured material to make them clearly visible.

There are a number of various other types of thermometers which are mounted on either wood, plastic or metal scales with the graduations either printed or engraved on them.

We hope this short talk will give some idea as to the basic methods of production used in the manufacture of liquid in glass thermometers.

1967 SYMPOSIUM

September 8th-9th at the University of Reading*

THE first day's proceedings began at 2 p.m. in the Lecture Theatre of the New Chemistry Department with an attendance of well over a hundred members and associates. Mr. S. D. Fussey, as chairman of the first session, announced that the address by Mr. I. Maddock, O.B.E., B.Sc., F.Inst.P., would, through unforseen circumstances, be delayed until the symposium dinner and then called on Mr. J. B. Patrick, B.Sc., of the Hirst Research Centre to talk on **Glass Engineering.**

Mr. Patrick began by saying that glass engineering became necessary as the lamp and valve industry developed and hand skill could no longer keep pace with demands. Without it there could never have been lamp production, TV and the many products of the industry on the present day scale. There are two classes of glass engineering; the first in which machines have completely replaced hand skill as in automatic lamp production, and the second being where machines have assisted and amplified glassworking skills. It was his intention to deal with aspects carried out on the glass shop floor as opposed to mass production. He then followed with a review of glasses, metals, and methods of making glass seals, together with the factors such as expansion, glass viscosities and oxidation conditions which must be satisfied for serviceable seals. Some recent methods of manufacture including the centrifuge technique were also described and examples of each type of metal glass seal were on view.

As an example of the use of the glassworking lathe the construction of a 250 KV 300 amp DC rectifier was described. This consisted of a large cylindrical bulb with tooled indentations and numerous metal seals, being constructed from Soveril glass and Nilo K alloy. Methods of tooling the indentations and jigs for holding the electrodes were described, the sealing operations being made feasible by using an external oven to keep the bulb at a safe temperature while local sealing is in progress and also to give a preliminary annealing while on the machine.

This was followed by a survey of cases involving the use of precision bore tubing with special reference to the travelling wave tube which besides being precision bore carries an internally moulded spiral. The "Shrink" and "Flood" methods of producing tubes were described and slides were shown to illustrate the making of standard frequency crystal holders which incorporates both flat section tube and the washer method of sealing by H.F. in a protective gas atmosphere or in vacuum.

Moulding techniques for multi lead seals were then described and the carbon moulds having been loaded with leads and glass, can be either fired singly, or on a larger scale, by running through an oven on a belt, or in batches using a centrifuge oven, the latter not requiring a top mould. In discussing graphite moulds a new technique developed at R.A.E. Farnborough, was of great interest. Fine high temperature graphite powder is mixed with a binder and after being impressed with the object is then fired. A fine grain mould results with detailed definition of the master used for "impression." Enquiries for further information should be addressed to Mr. Bickerdyke of R.A.E.

The talk concluded with references to other types of glass metal seals such as stainless steel (EN 58B) to lead, and fused silica to tungsten. Then followed a short series of questions competently answered by Mr. Patrick. The final ovation showed the great appreciation by members of the talk.

After the tea interval, Mr. C. D. Reid, A.Inst.P., of A.W.R.E. gave a short talk on **Fibre Optics.**

Beginning in jocular fashion, by classifying methods of glassworking as either cold and wet or hot and dry, he considered that fibre optics was a meeting point of both processes and the techniques had been in existence for many thousands of years. J. L. Baird had mentioned the use of fibre optics for television in an early patent (1923) but had not given specific uses whereas C. D. Mansell in 1927 had covered many of the present applications and Mr. Reid used a picture of his specification as a basis for his description.

The conditions necessary for successful piping of light by each fibre are that there must be no loss by scattering and absorption within the glass, and above all fibres must not be in contact with any other material such as grease which would upset internal reflecting surface.

The great break through was made in 1940 when methods were found to sheath each fibre

* The Editor is indebted to Mr. F. Porter of the University of Bristol for his comprehensive description of the proceedings on which this report is based.

in glass of lower refractive index to protect the inner reflecting surface. Still using the Mansell illustration, examples were given of how fibre optics can be used to transmit pictures and change the cross section and depth of an image. Then going back four thousand years, Mr. Reid showed pictures of ancient Egyptian mosaic glass, ornamental beads, dishes, slabs and vases in which the millefiori ornamentation had been achieved by fusing in minute slices of rods which had been built up of fibres to form the picture. The techniques of cutting and fusing glasses of different colours must have been known long ago. Mr. Reid then surveyed the modern uses of fibre optics in the surgical field, for correcting optical curvature in image converters, and for single source instrument panel illumination, together with other possibilities.

The audience were most impressed by the lively style and speed and accuracy of the lecturer making it easy to understand the subject in the minimum of time.

The final talk of the day was by Mr. D. F. Rousell, M.I.S.S.O. on **Radiation and its Effects on the Tissues of the Eye**.

The general theme of this talk was that the organs of sight, hearing and respiration are vital to physical and mental health but can be easily damaged. Mr. Rousell described the structure of the eye and the damaging effects of ultra violet and infra red radiation which can occur as a result of welding and other processes. The only real protection is by using filters which absorb ultra violet and infra red. Various types are now available but only those for which absorption and transmission curves are issued are really suitable.

In the future another class will be needed for eye protection from the intense thermal shock which can be caused by lasers.

It was regrettable that owing to lack of time Mr. Rousell could not give the complete lecture and no time was left for questions. As some compensation we are able to publish the full text (page 29).

At the conclusion of Mr. Rousell's paper, members adjourned to the Buttery where the Symposium Dinner was served.

The highlight was the speech made by Mr. I. Maddock, O.B.E., who said that having had early experiences of glassblowing using foot bellows and an old cannon burner, he and his Ministry regarded the scientific glassblower with great respect. He described the influence of modern technology in industry which has resulted in some production being completely automated. He expressed the view that as a country we should, like Japan, concentrate on industries of low material content involving high skill rather than the traditional British heavy industry. We must also revise our conception of trade skills and in the future scientific glassworking with its associated techniques will have a great part to play. We must be ready to meet the challenge. The existence of our Society was an indication that we are conscious of this progress and the Ministry of Technology is prepared to help us to prosper. Mr. Maddock concluded by thanking his audience for listening with the hope that he would come again.

In reply, Mr. E. G. Evans the Society chairman, thanked Mr. Maddock for honouring us with his presence and promised that his offer of help would be accepted. Mr. Evans felt that this recognition by the Ministry of Technology was a wonderful boost to the Society and its aims. He assured Mr. Maddock that the present day glassblower was fully aware of the new techniques coming along and was fully prepared for any challenge these new techniques may offer. Mr. Evans continued by thanking those members who had supported the Symposium and offered on their behalf a vote of thanks to the Thames Valley Section, who had organised the meeting, including the catering staff who had provided the dinner.

After dinner members were invited to return to the trade stands where demonstrations of various glassworking techniques were being given by members. These included metal-glass seals from powdered glass paste, platinum glass seals, and ultrasonic drilling of 0.8 mm. holes in capillary tubing.

Other operators were discussing techniques used in the manufacture of components on show including some wonderful Kerr cells. The trade exhibitions were well supported, exhibitors realising the potential of this select gathering had laid on some splendid equipment. During this period a series of excellent technical films were also shown after which members were invited to finish the evening in the University bar.

The second day of the Symposium opened with an apology from Mr. R. M. Carter that he was unable to attend owing to a close family bereavement. He had, however, sent his paper along which was read by Mr. J. W. Price, the session chairman.

Temperature Control of Furnaces

This covered all aspects of the design of glass annealing furnaces, various types of temperature controllers and switches with their uses, heating elements and the materials used in oven construction. When published, this highly informative paper will be of great value to the glassblower wishing to construct his own furnaces and lehrs.

After coffee Mr. B. Hodgson of English Electric Co. Ltd., followed with his talk on **Glass ceramic to Metal Seals.** Opening by remarking that glass ceramics, called Mexims industrially, were accidentally discovered at the Corning Glass Works while making photosensitive glass. The heat treatment of some samples was allowed to overrun which resulted in crystallisation of the glass and the formation of extremely strong materials. Glass ceramics are made by the controlled and catalysed crystallisation of initially homogeneous glasses which converts them into polycrystalline ceramics. Many types of glasses can be used for Mexims, their choice being governed by a number of factors. It is important that they should crystallise rapidly with heat treatment so that many normal commercial glasses are not suitable. Melting point and viscosity must be taken into consideration for economic fusion and shaping, together with corrosion of the linings of furnaces used in their manufacture. Generally speaking, Mexims have high volume resistivity and are suitable for high voltage applications. On conversion to the ceramic phase they become much more refractive, their softening points rising from 100°C to 500°C above that of the parent glass. Mexims can be sealed to metals such as stainless steel, molybdenum, nickel and Nilo 48.

There are two basic techniques. In the first, the Mexim is cut and ground to shape and sealed to the metal using an intermediate bonding layer of glass or metal braze. These seals have a very low leak rate ($<10^{-8}$ Lusecs) and high mechanical strength. In the second method of direct sealing the parent glass is first sealed to the appropriate metal and the resulting seal heat treated to convert to the ceramic glass.

Seals can also be made by assembling studs or electrodes in a carbon jig, adding glass preform then heating to fuse the glass and make the seal, followed by heat treatment to form the ceramic. Devitrifiable glasses can also be used to form a seal between components by fusing locally. Solder glass seals can also be made.

Mr. Hodgson then discussed the manufacture of photosensitive glass ceramics.

On display were examples of "Pyrosil" oven ware, a glass ceramic composed of lithium, aluminium and silicon oxides. A radome which houses the aerials of rocket missiles was also on show and Mr. Hodgson pointed out that few people realised the severe attack by rain and thermal shock to which they are subject, but

Presentation of Woods and Jobling Trophies by Dr. H. R. Pitt glass ceramics have all the qualities needed including easy fabrication.

Heat exchangers can now be made from glass ceramics of nearly zero expansion, and other uses are protective coatings for metals, substrates for electrical circuits, high voltage insulators, underwater structures and high temperature bearings. Mr. Hodgson is an expert in this field and his highly technical but informative lecture was supplemented by many slides and was well received.

Lunch was followed by the **presentation of the A. D. Wood and J. A. Jobling cups,** the ceremony being performed by Dr. H. R. Pitt, Vice Chancellor of the University of Reading. G. Hepburn was the winner of the Jobling cup and the A. D. Wood cup was won by R. Gannon. Owing to illness both were unable to be present and a deputy acted on their behalf. Dr. Pitt thanked the Society for inviting him to present the award and added that he had watched our progress over the years and hoped that we would go from strength to strength; he himself would give any help or encouragement he could.

For the afternoon session Mr. J. A. Frost took the chair, the first paper being on **High Power Gas Lasers by D. J. Hunt, B.Sc**. Beginning with an explanation of the word Laser, which is an abbreviation for Light Amplification by Stimulated Emission Radiation, he then indicated the vast number of publications and enormous amount of money being spent on laser research. He also said how much people carrying out research in this field owed to the glassworker as their construction in silica needed great skill.

It would be difficult to give an adequate review of the highly technical talk which followed and which will later be published in full.

Mr. Hunt concluded by stressing that great care should be taken when working with laser beams and eye protection was of paramount importance; even reflected rays could be dangerous.

British American Optical Company, one of the exhibitors, distributed leaflets from their stand containing information on special goggles available for use when working with lasers.

Quasi Fusion of Optical Cells was the title of the last technical paper of the Symposium and was given by F. J. Rumble of Whylems Ltd. He began by saying that most people were familiar with the cuvettes used in absorption spectrophotometry by which solutions or solids could be analysed and, providing cells could be made to a standard depth, uniformity of results could be guaranteed. Cells are made to BS 3875 and usually of crown glass or synthetic fused silica. The cells consist of three parts, windows and the separator which, in the case of the open top type, is made by bending round a former and is ground and polished flat and parallel to an accuracy of 0·02 mm., which is well within the B.S.

The surfaces to carry the window were then further polished to 1 Newton fringe per cm. This standard of accuracy is needed so that in the actual heat fusion which follows there shall be no distortion of the optically flat window surfaces. Sometimes during checking for flatness on an optical test plate a contact seal is accidentally made with disastrous results.

All parts are cleaned in chromic acid, washed in solvents, dried and dusted with a squirrel brush. They are then assembled in a jig and put into a furnace which, starting from cold, is heated to just above the annealing point but below the softening temperature. How much depends on size and the material. The furnace is then allowed to cool and the cell left in until completely cold.

As suitable materials for moulds for silica are not available, these are usually fused under pressure using a naked flame.

In conclusion Mr. Rumble said he could not give exact temperatures and conditions but anyone by trial and error could soon obtain satisfactory seals. Of course allowances have to be made for different shapes and materials.

A novel way was chosen to terminate the Symposium. Mr. J. Downham of the International Brotherhood of Magicians gave a display entitled the "Magic of Glass" which was a light hearted exhibition of the conjurers art using all glass apparatus. It took several minutes for the audience to realise what was taking place but most agreed that this unorthodox way of unwinding the technical proceedings was a good one.

In general the selection and presentation of papers was faultless which, together with the carefully planned arrangements, made this Symposium, as was intended, the finest yet and very rewarding to those who attended.

There were approximately 150 present on each day and the Thames Valley Section who were responsible for the organisation are to be congratulated on their achievement which has also helped to advance the prestige of the Society. Knowing how much work is involved in promoting a Symposium on behalf of the Society we thank all those involved.

SECTION REPORTS

Western Section

Although meetings are normally held in Bristol, the success of last year's meeting at Cardiff University was repeated in May, in all over twenty members attending from South Wales, Bristol and as far away as Malvern.

The evening began with a film on neon sign manufacture which starred Mr. Dennis Jones of Bristol, the commentary also being given by him. The film illustrates bending techniques, the construction of a letter "A" followed by fluorescent coating technique, pumping and finishing procedure.

Mr. Jones then gave a further talk on glass bending in connection with the neon sign industry entitled " Round the Bend," in which he showed how, with the aid of a 10in. ribbon burner, various types of bends are made, including a " sheet bend " knot tied in glass tubing. Mr. Jones pointed out the difficulties which arise in the manufacture of complex signs and the need for the " bender " to have perfect co-ordination of hands and eyes. During question time, a great deal of useful information emerged and the chairman, Mr. Garrard, in calling on members to show their appreciation of Mr. Jones's efforts, pointed out that the fact that the neon sign trade normally operates under secrecy, makes Mr. Jones's talk even more valuable.

The next part of the programme was a very fine film in colour entitled " Well I'm Blowed " which shows in a light hearted manner the manufacture of glass containers of all types and also design requirements.

Mr. R. Garrard proceeded to give a short talk entitled " Get cracking " which described the principles involved and methods used in cutting and parting glass, both mechanically and thermally.

In conclusion thanks were given to all those who participated in the evening and to Prof. A. G. Evans, of the Chemistry Department, University College, South Wales, for the use of departmental facilities.

In June, the Section annual works' visit was to Messrs. Quickfit and Quartz factory at Stone, Staffordshire, and the following description by Mr. F. Porter has been extracted from *Revue*.

The factory, of modern design, is set in pleasant surroundings with plenty of room for future expansion programmes. We were met at the gate by Mr. Smith of Q. and Q., who gave us an outline of the route we would take around the works.

We first went to the stock department where the basic glass vessels received from Joblings were stored. The pipeline buttress joints were in the form of a pressed " Basin," the bottom being cracked off before use. Other components of a complex nature were also shown to us. We were asked to keep to some sort of gathering but no pressure was brought on us to keep moving, we were allowed to stop by any operator and watch at our leisure. Some very intriguing coils were being made at one section and here we saw operators making coils with the utmost of ease, some of us would be most certainly unable to compete with their individual skill. The flat type of coils were wound with unerring accuracy; a rather crafty way of getting flatness was to heat, then after forming in a furnace at a predetermined temperature they were withdrawn from the furnace and literally " ironed " flat with a large flat iron. One group of chaps were joining the sections of coils together into piles, for assembly into heat exchanger jackets, and I was told that no leak tests were carried out on the coils prior to building into their jackets.

We went on to the very spectacular 18in. and 24in. pipeline machines; here operators did things to glass which I would have had second thoughts about. Insertion seals in 18in. tubes makes me wonder how I sometimes get a failure doing a bench blown piece of apparatus. Of course these operators do not generally do any other operation than the one they are trained in, so they have the techniques worked to a fine art. Some of our younger members were most intrigued and I feel they got great confidence from watching people work the really big stuff. Of course we saw operators doing all the smaller items such as stillheads and separating funnels, stopcocks, etc., with no lesser degree of skill, and we saw many ingenious devices and jigs for ensuring repetivity and uniformity.

Although the amount of heat involved was considerable, the factory which had a high roof was well ventilated. The welfare of the workers was certainly to the fore; slot machines dispensing sweets, chocolate, coffee, soup, minerals, cigarettes, etc., were plentiful and operators would stop and get what they wanted when they wanted it. Tea breaks did not exist as such, operators who work a bonus scheme suited themselves when and where they stopped.

We next saw the new clearfit joint being made on filter flasks; the socket is made in the orthodox way (moulded on the flask) and then it is evacuated on to a stainless mandrel and the socket reheated with the flame traversing along the length of the joint at a controlled rate. There was quite a section doing this work but for security reasons we were not able to see too much in detail. Mr. Smith took us into a large building which houses a new line by Q. and Q.—plastics moulding. Here large injection moulding machines were turning out the popular screw cap fitting, the "E/MIL" stoppers and cup holders for "Pyrex" ware. It is anticipated that other firms may call on Q. and Q. for plastic products other than laboratory ware. Also in the department was the assembly of counter current machines and other equipment for export. In conclusion, Mr. Smith took us to the works canteen for tea. Here we were introduced to the technical and sales managers and invited to ask questions. Mr. S. Yorke was also present. Members may remember my remarks when we visited the STC works at Paignton, regarding the use of natural gas. Q. and Q. have a team carrying out research into burner functions as they are expecting North Sea gas next year. The day is not far off when we also may be involved in the same problem.

After thanking our hosts we left Stone, some by private cars, the others by coach. The route we had taken to Stone was via the Severn Bridge and the Wye Valley, members from South Wales were picked up on route. Some 18 members took part in what was a most instructive and entertaining outing. Our thanks to Q. and Q. and to our secretary who organised it.

The July lecture on vacuum measurement took place at the Physics Department of Bristol University, and was given by Mr. C. Snaith who is a member of a research group headed by Dr. D. Klemperer. The talk was a follow-up on a previous lecture by J. H. Burrow, and the principles and operation of a comprehensive list of gauges of all types were discussed.

It is hoped that Mr. Snaith will offer his paper for publication in the Journal.

North-Eastern Section

After the A.G.M. our first meeting was on April 28th. A lecture on ceramics was given by Professor J. P. Roberts of Leeds University. The lecture was very enlightening as regards the range of substances classed as ceramics, which included anything from rocket nose cones, carbon magnets, cups and saucers, house bricks and of course various types of glass. After the lecture, Professor Roberts kindly invited our section to have a visit to the Ceramics Department of Leeds University, which will be held on November 17th. It was a great pity that there were only a total of 15 people present at such an excellent lecture.

On the 30th June we had a lecture on lasers given by Professor O. S. Heavens, F.Inst.P., of York University. He explained the basic principles of lasers and then went into the uses of them. One of them, which was very interesting, was the development of small lasers in the dental field. The attendance at this lecture was much better with a total of 25 people.

Future events which are in the process of being arranged are a talk, with demonstrations to be given by a spokesman from Thermal Syndicate Ltd., and a Jobling Evening, which is to be held in 1968.

D. H. BANCROFT

Thames Valley Section

Programme 1967-68

October 5th, 1967, at Reading University
Vacuum Deposition of Thin Films on Optical Surfaces, by a member of A.W.R.E.

November 2nd, 1967, at Oxford
North Sea Gas
A member of S.G.B. will lecture and show a film on the implications of North Sea Gas

December 7th, 1967, at Reading University
Workshop Session

January 4th, 1968, at Reading University
Decoration of Glass by Mr. O. N. Collier of Johnson Matthey

February 1st, 1968, at Oxford
Silica Working by Mr. H. Baumbach
Mr. Baumbach will give a demonstration of silica working and show a new film that he has made

March 7th, 1968, at Oxford
Workshop Session and A.G.M.

April 4th, 1968, at Reading University
Leak Rates in Glass to Metal Seals by Mr. R. Bloomer
Mr. Bloomer will talk on his recent work in this field

May 2nd, 1968, at Oxford
Grinding of Optical Surfaces by T. Wood

East Anglian Section

At the June meeting Mr. A. Ball, Assistant Process Manager of Key Glass works gave a very interesting talk with illustrative films on bottle manufacture. Twenty members were present. Mr. Ball described how methods of production have developed over the past two thousand years leading to the present automated system which was described in detail from the glass tank through the moulding process to the final inspection and packing. Many examples of old and new glass containers such as sauce bottles, pickle and jam jars and soft drink bottles were exhibited in order to illustrate the advances which have been made in this field. The film entitled "Well I'm Blowed," supported with more detail, Mr. Ball's description and a second one which followed by Owens-Illinois gave preference to the advantages of using glass instead of metal for the food packing industry, one strong one being that the contents were visible.

Many questions were asked, and Mr. Ball showed that in addition to being a very capable speaker, he was ready with the answers to some searching requests. His interesting talk can be recommended to other Sections with vacant dates.

E. G. EVANS

LETTER TO THE EDITOR

Sir

The Seventh Annual Symposium of our Society has come and gone, with many sighs of relief from all those engaged in putting it on.

After the last guest had departed and most of the trade exhibits had been dismantled, Jim Frost, Dave Henson and I had a few minutes quiet discussion and a couple of cups of tea in the unusual surroundings of the university goods lift—stationary of course! This discussion revealed that a number of participants had openly stated that the Symposium had been a success and, suddenly, we doubting Thomases knew that it was all worthwhile.

I must take this opportunity to say a sincere thank you to my committee for their devoted efforts to make this seventh event a real success, and I must name Jim Frost, Dave Henson, John Price, Jim Darvell, Cliff Edwards, Max Noad, J. Macdonald and John Swarbrick. To these men, through your columns, I publicly offer my personal thanks, they were a grand team, and I hope future symposium chairmen are fortunate enough to have men of similar calibre on their committees.

STANLEY D. FUSSEY

Chairman, 1967 Symposium Committee

Members of 1967 Symposium Committee

1968 SYMPOSIUM
Lytham St. Annes, Lancs

May I remind members who have any intention of attending this Symposium that accommodation is going to become increasingly difficult in the next few months and a provisional booking now will not cost anything at this moment and may avoid disappointment later. All enquiries to J. Stockton, Unilever Chemicals Development Centre, Bank Quay, Warrington.

OVERSEAS APPOINTMENT

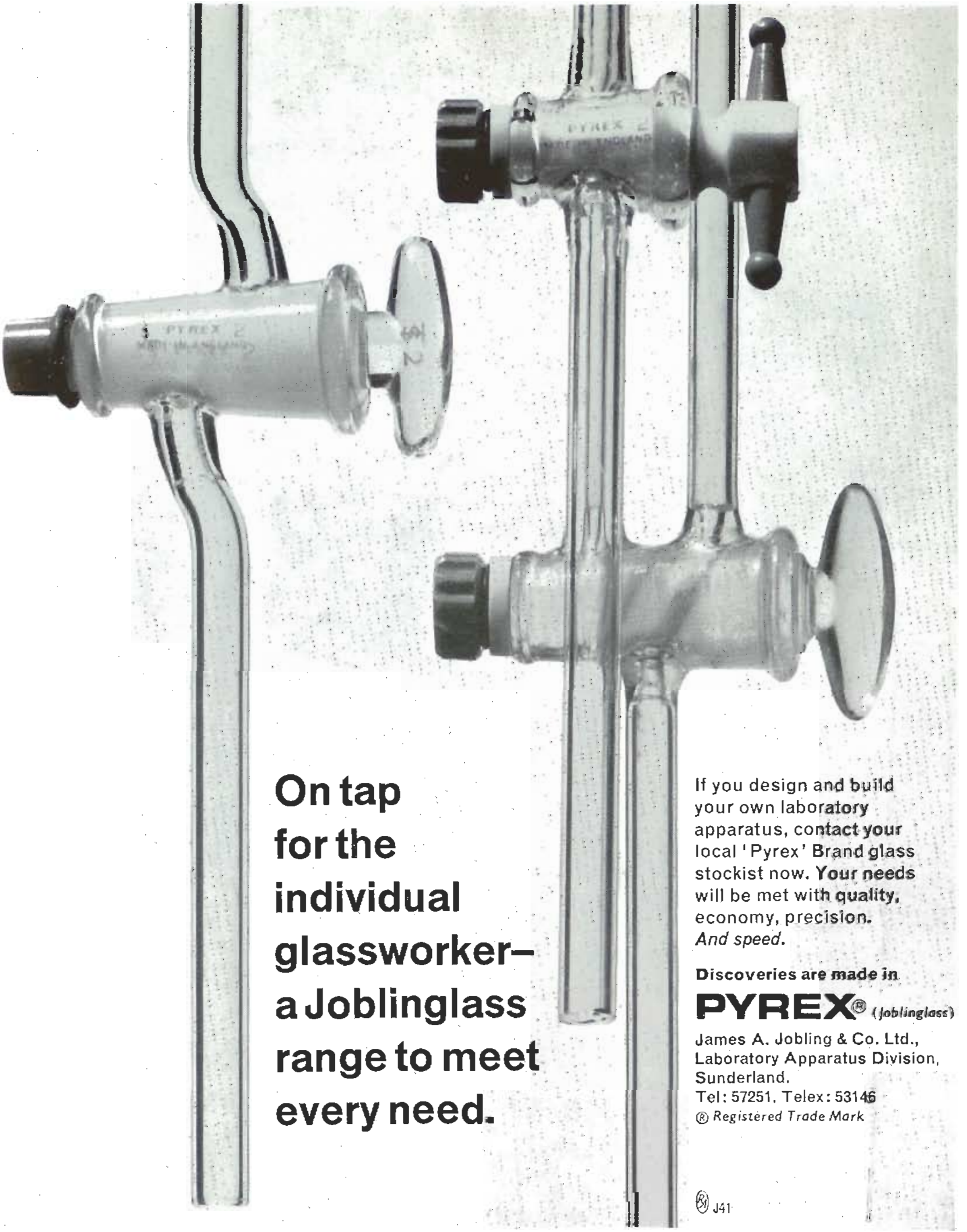
Mr. D. E. Roberts of the Export Marketing Department of James A. Jobling Ltd., is acting on behalf of a firm in Johannesburg, South Africa, to find a glassblower. The following summary specification is for guidance and can be deviated from: Male, single, about 24 years old. Salary £100 per month (equivalent to about £120 U.K.). Starting date as soon as possible. Initially a six months' contract with air fare to Johannesburg. Prospective applicants please contact Mr. Roberts.

OBITUARY

It is with regret we have to record the death of Mr. G. H. Springham founder of the firm of G. Springham & Co. Ltd., of Harlow, Essex. He was 61 and had been in the glassblowing business for more than 40 years.

Mr. Springham will be remembered for his work in connection with the development of the manufacturing and unique testing techniques of the world renowned INTERKEY range of interchangeable key stopcocks and apparatus.

The management and progressive policy of the company continues under the direction of the remaining Directors, Mr. F. L. Ranson and Mr. A. C. Walker.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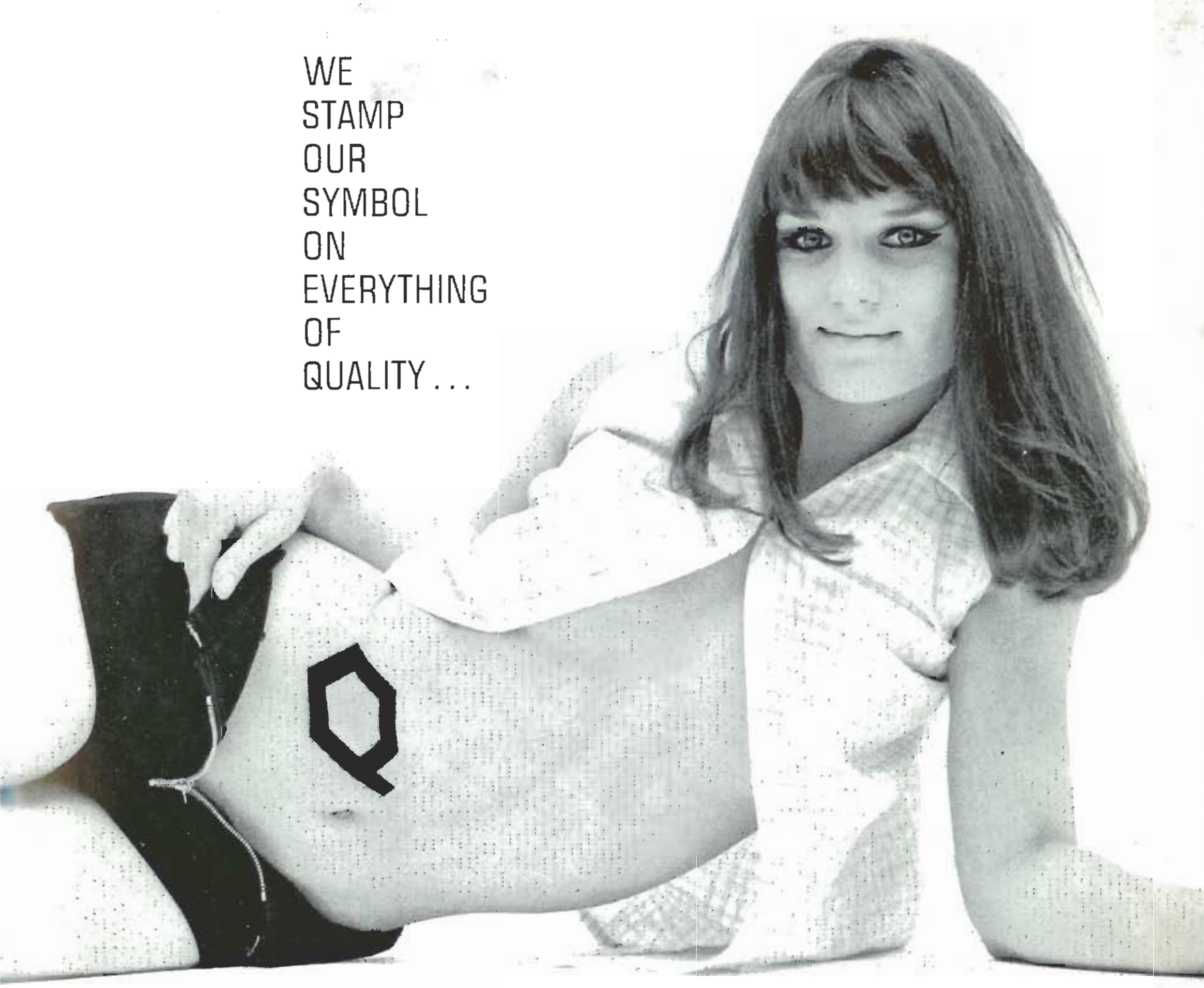

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