R_f values* of some amines and amine derivatives (Munkelt *MOB* paper, temp. 20–23° C.)

	Reaction to		<i>n</i> -Butanol, 40%; ethanol, 10%; water, 50%	<i>n</i> -Butanol, 40%; acetic acid, 10%; water, 50%	<i>n</i> -Butanol-phenol†
	Iodine	Ninhydrin			
I. Amino-acids					
Glycine	+	+++	0.16	0.32	0.04
Alanine	+	+++	0.22	0.39	0.09
Serine	+	+++	0.20	0.28	0.03
Threonine	+	+++	0.23	0.35	0.05
II. Amines					
Amino-ethanol	++	++	0.31	0.43	0.34
Histamine	+	++	0.32	0.25	0.73
Glucosamine	+	++	0.30	0.28	0.09
III. N-methylated amines					
Monomethylamino-ethanol	++	+	0.41	0.45	0.49
Dimethylamino-ethanol	++	(+)	—	0.47	—
Choline	+++	—	0.19	0.45	0.45
Sarcosine	++	++	0.24	0.36	0.10
Betaine	+++	—	0.26	0.40	0.34
Acetylcholine	+++	—	0.31	0.48	0.60
Neurine	+++	—	0.23	0.46	0.55
Trimethylamine (-sulphate)	++	—	—	(0.43)	—
Trimethylamine-oxide	+++	(+)	0.36	0.54	0.61
Adrenaline	+	+	0.24	0.47	0.24
IV. Guanidine bases					
Arginine	+	+++	0.12	0.14	0.07
Guanidine	++	—	0.27	0.50	0.41
Guanidine-HAc	sl. +	—	0.21	0.39	0.12
Creatine	sl. +	—	0.22	0.37	0.11
Creatinine	+++	—	0.43	0.50	0.48
V. Purines and pyrimidines					
Adenine	sl. +	—	0.17	0.35	0.06
Xanthine	sl. +	—	0.12	0.36	0.05
Guanine	sl. +	—	0.13	0.37	0.12
Uracil	sl. +	—	0.13	0.34	0.08
Thymine	sl. +	—	0.13	0.36	0.07

* *R_f* values indicate the ratio between the distances of the substance and the solvent fronts from the initial position of the substances.

† 20 parts of water-saturated *n*-butanol mixed with 7 parts of water-saturated phenol were separated and the upper layer used in the trough.

nitrate, *m*-diphenylendiamine), picrate solution. After ninhydrin treatment, a paper may be developed by iodine (preferably by spraying) with similar results as though ninhydrin had not been used.

A great many nitrogen-containing compounds examined (in spots in most cases containing about 20–30 μgm. of substance) gave positive reactions of varying intensity and quality. I was especially interested in certain amines and their N-methylated derivatives, known or expected to be constituents of lipids. Most of the substances tested of this class gave very distinct and characteristic brown to flame-coloured spots. But various amino-acids, guanidine bases, pyrimidines, purines, etc., also were coloured, though in most cases much more faintly. Subsequent to iodine development most amino-acids gave the usual purple colour with ninhydrin; but some, for example, tryptophan, histidine and cysteine, retained iodine for a long time, thereby modifying the ninhydrin colour to a browner tint.

The method may be of value in qualitative analysis of mixtures containing only a few positively reacting substances. Thus it was found very suitable for my own purpose, namely, a study of nitrogenous constituents in lipid hydrolysates (to be published elsewhere).

Data for some solvents used in these studies are collected in the accompanying table. Several other solvents have been tested and found less useful; thus it may be mentioned that in water-saturated phenol alone the methylated amines move unduly fast, and that nitrogenous solvents, due to their own reactivity with iodine, must be very thoroughly removed before iodine treatment, and therefore some of them are less convenient.

Due to their volatility, trimethylamine and dimethylaminoethanol do not appear at all, monomethylaminoethanol only with reduced strength on papers run in neutral or alkaline solvents in air. After adding one or two per cent of acetic acid to the solvent, the foregoing substances will be retained in the paper. Such solvent mixtures are now being studied.

Hitherto I have examined mainly substances which might be expected to be constituents of lipids or contaminants in lipid extracts. Purines and pyrimidines, owing to their slight solubility and faint iodine reaction, will probably not lead to errors in lipid analysis by the iodine reaction. On the other hand, the strongly reacting creatinine was identified in a distinct spot, deriving its origin from an alcoholic fraction of a lipid extract of a brain in uræmia.

In the table may be noticed several examples of the influence on its chromatographic behaviour of an OH- or CH₃-radical entering into a substance. This may be of some guidance in interpreting unknown spots.

Also in quantitative experiments with paper chromatography, iodine may prove convenient by revealing the position of the substances to be estimated; particularly as the iodine later sublimes, leaving outlined spots for excision, soaking and chemical or physical determination.

The ready formation of iodine addition compounds by amines and amine derivatives seems to be the cause of the iodine reaction, at least in most instances.

VISUAL AIDS TO EDUCATION

THE application of visual aids to education has been stimulated during the last decade mainly because the value of the still and motion picture projectors is being increasingly realized. Visual aids have existed for a long time; but it is only comparatively recently that their significance as an educational medium has been fully appreciated. This was recognized by the Havard Report on "General Education in a Free Society", which states: "Traditionally language deputises for what has to be absent. It tells us what we might see or hear. But it too often gets in the way of, or replaces, all that could give it a meaning. Now that the things and events themselves can be brought to us, the role of language is reversed. Instead of words having to explain or represent things, it is rather things or actual processes taking place before us, which explain words or call them in question."

To-day visual aids to illustrate and explain the written or spoken word are commonly used in the form of pictures, charts, diagrams and plays, while there is a growing interest in, and use of, still and motion pictures. The use of the latter in education was discussed by Mr. R. Beloe, chief education officer of Surrey County Council, in his address to the Education Section of the British Association at

Brighton. The address has now been reprinted by the National Committee for Visual Aids in Education.

Considering the place of the filmstrip projector as the successor to the old magic lantern, Beloe suggests that this device may be increasingly used, not so much as an aid to a lesson but as a lesson in itself, emphasis being placed more on the image seen than on the words read or spoken. More than the radio it could be used to project into hundreds of classrooms the identical ideas of a single teacher; every school should have its filmstrip library.

Yet however vast the potentialities of still pictures in education, those of motion pictures, which entertain for good or ill some 250 million human beings weekly, are even greater, particularly when full use may be made of natural colouring. Various investigations before 1939 recorded the value of the film in teaching. It helps children to remember; it awakens interest and secures sustained mental concentration; it stimulates, by putting a point of view different from the teacher's, and by compelling the pupil to find his own words to express opinions and to describe scenes; it supplies material for the exercise of reasoning faculties. In other words, it can enlarge the experience and broaden the outlook of pupils, and bring a sense of reality into the classroom. It can also broaden the outlook and knowledge of teachers and act as a stimulus to them.

By 1939, therefore, any doubt about the film's value as a teaching tool had vanished from the minds of those who had closely studied the matter. The real problem was one of logistics, and, until this was solved, little progress could be made.

The position was described in a 1946 report by Political and Economic Planning, from which it was made clear that there was a vicious circle. Lack of good educational films led to reluctance on the part of local education authorities to equip the schools with projectors. As there was, therefore, only a small market for educational films, it was not an economic proposition to produce them in great quantity. Recently it has been estimated that there are some two thousand instructional films of varying quality, types and value available in Great Britain. A large number of these, although for want of something better labelled as 'educational', are practically useless for teaching purposes. So far as can be ascertained, in 1946 there were fewer than four hundred sound projectors in schools in England and Wales. Of the 1,700 silent projectors available, many were unsuitable for classroom use.

These shortages of suitable films and projectors were due less to lack of enterprise than to lack of means. In the United States, where money is available, it has been stated that in the city of Los Angeles there are more than double the number of sound projectors in the whole of Great Britain. During the War the use of films by the armed forces of the British Commonwealth and also of the United States, as well as the lessons which had been gained from excellent documentary and propaganda films, again focused attention on the merit of the film as a teaching aid and on the paucity of supply.

In 1945 there was every reason on educational grounds why progress should swiftly be made in developing the use of visual aids by methods of projection as an integral part of teaching method. The lead was taken by the County Councils' Association, which, together with the Association of Municipal Corporations and the Association of

Education Committees, as well as the National Teachers' Association, submitted a memorandum to the Minister of Education. As a result, two committees were set up in 1946. One, named the National Committee for Visual Aids in Education, was made up of representatives of teachers and local education authorities and had the duty of planning a visual education policy, collecting and collating views, nominating practising teachers as educational advisers to the producers of films, developing regional film libraries and encouraging authorities to purchase suitable films, advising on the supply, selection and maintenance of suitable apparatus and carrying out research. But the essence of the scheme was to be found in the Committee's relationship with the Minister. The Committee was to determine the films which are needed, and the Minister, subject to reasonable safeguards on the score of economy and the national interest, was to commission the films through a Production Committee, on which the National Committee, the producers of visual material and apparatus, the Ministry itself and the Central Office of Information were to be represented. The films thus produced were to be purchased by the authorities and schools.

At first the Central Office of Information was made responsible for the placing of films in production; but, in order that all suspicions of propaganda should be removed, it was later decided to set up a new organisation which would replace the Central Office of Information so far as educational films and other visual material was concerned. This body, the Educational Foundation for Visual Aids, is independent of the Government and has been supplied with a loan of £130,000, which is repayable to the Exchequer. Its function is, first, to market and distribute the films and other material which have already been commissioned.

Where commercial producers are prepared to take the financial risk of making a film they will be able to do so, and the Foundation will include the film in its catalogue of films, which it will supply at the stated price, receiving a discount from the production company. Where no producer is willing to take the financial risk the Foundation may either commission the film and retain the rights, or place with the producer an advance order for enough copies to enable him to finance the project. It is expected that, if necessary, the Foundation will take similar action with filmstrips.

Thus there has now been set up machinery to find out what films the schools require, for placing the work with the producers and for enabling both great and small to produce them, for providing the producers with advice from a practising teacher during production, and for marketing and distributing the finished articles.

Much more still remains to be done. First, there must be local libraries of all films likely to be in constant use by the schools, with facilities for teachers to view them. Secondly, there must be set up regional libraries for less widely required films. Thirdly, there must be a similar catalogue of filmstrips; but of these a library is needed in each school, for they are comparatively cheap and easily stored. Nevertheless, a central collection so that teachers may see what can be purchased for their schools will be needed in each authority's area.

Fourthly, the projectors for showing the material must be made available for purchase and must be purchased by local education authorities.

Fifthly, the local education authorities must make arrangements for the repair and servicing both of films and of apparatus.

Sixthly, but by no means least important, the teaching profession must be shown how to handle the medium. Up to the present the filmstrip and the film have been used mainly by enthusiasts. All teachers whose lessons can be improved by the use of visual aids should be trained to use them. It is therefore incumbent on all local education authorities to provide teachers with the facilities for acquiring that ability.

Lastly, a great deal more information based upon careful research is needed before educationists can regard themselves as masters of this medium. Scotland has produced two valuable reports which contain important statements about the subjects on which films should be made, the length of film suitable for children of various ages, and the value of sound films. These conclusions and others formulated in the 1947 Progress Report of the National Committee for Visual Aids in Education need testing. It is perhaps most important of all to ascertain the value of the film in teaching children of differing grades of intelligence and of its use in the teaching of adults.

T. H. HAWKINS

81

SUMMER SCHOOL IN ELECTRICAL ENGINEERING AT RUGBY

DURING July 12-16, 1948, the British Thomson-Houston Co., Ltd., held, at its Rugby works, a summer school in electrical engineering, which was attended by members of the staffs of the electrical engineering departments of universities and technical colleges, together with representatives of the Service colleges, the Ministry of Education, the Institution of Electrical Engineers, and Government research organisations. In the "Proceedings" of the school, published recently by the Company, are recorded the scientific papers presented by members of the Company's staff.

These papers give an interesting cross-section of the activities of a large electrical manufacturing organisation. Materials, for example, are represented by two papers, one on magnetic sheet-steel and the other on modern developments in electrical insulators. A review is given of some of the mechanical problems affecting the design of electrical machines. Several papers deal with design problems of the magnetic and electric circuits of rotating electrical machinery and one with the design of insulation for high-voltage transformers. Power systems receive attention in papers on switchgear, protective gear and power system analysis. Rather more than half the papers are concerned with electronics or high-frequency phenomena and applications. The fundamental theory of communication forms the subject of one paper, and magnetron generators, pulse modulators and micro-wave transmission techniques are covered by a group of papers. In the field of electronics there are contributions dealing with fluorescent discharge lamps, arc control in gas-filled valves, the application of the mass spectrometer to leak detection in high-vacuum systems, and a development of the betatron.

One of the most valuable features of this collection of papers is the indication given in many of them of the trend of development and of the directions in

which research in university departments could contribute towards the solution of some of the more fundamental problems. Having regard to the fact that these lectures were prepared by members of design and development departments as well as of the research department, it is perhaps worth while to record the impression that the scientific requirements of design and development are scarcely less stringent than those of research. Of particular interest is the opening address given by Sir John Cockcroft, in which the needs of Great Britain for scientific and technical staff are reviewed.

THE AGORA OF ANCIENT ATHENS: A STUDY IN ARCHÆOLOGICAL RECONSTRUCTION*

By PROF. HOMER A. THOMPSON
Institute for Advanced Study, Princeton

THE excavations which are being currently conducted by the American School of Classical Studies in the Agora, or civic centre of ancient Athens, have led to the identification and restoration of many ancient buildings through the combination of evidence drawn from ancient authors, inscriptions and the exploration itself. As a specimen to illustrate the procedure, the Odeum, or Concert Hall, may be selected.

The remains of the Odeum have been identified from a reference in Pausanias, the 'Baedeker' of the second century. Its date of construction is fixed in the Augustan period, partly by its architectural style, partly by the pottery associated with its foundations and partly by its specific name, the Agrippæum, which suggests that the building was erected by Agrippa, the minister of Augustus.

A close study of the foundations of the building and of scattered marble blocks from its superstructure has permitted the recovery of its architectural scheme in all essentials. The building proves to be unique in its dual nature, comprising as it did a core, in which were an auditorium, stage, dressing-room and lobby, and around the core a raised balcony that opened outward for the accommodation of spectators who might wish to view processions or ceremonies in progress outside the building. Of particular interest among the architectural details of the original period is the stage front, which was decorated with a marble screen supported by terminal figures alternately male and female.

The siting of the building on the axis of the Agora square is reminiscent of the contemporary Forum of Augustus in Rome, while its scheme of lighting through an open colonnade at one end was inspired by the Erechtheum; hence its design may be the work of a team of architects, some Greek and some Roman.

The building collapsed and was afterwards remodelled (as shown by stamped roof tiles) about A.D. 150. The remodelling involved reduction in the capacity of the auditorium from 1,000 to 500, and in the conversion of the original dressing-room into

* Abstract of a Friday Evening Discourse delivered at the Royal Institution on February 18.