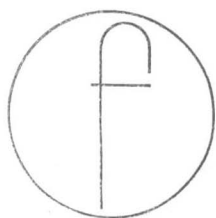


The
Focal
Dictionary
of
Photographic
Technologies

D A Spencer



The Focal Dictionary of Photographic Technologies

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Publisher's Preface

The pace of technological change in our time compares with the mode of its progress a century ago as does the speed of a supersonic aircraft with that of the 19th Century railways. The problems of intelligible communication between sectors of contemporary technology and even within some of its sectors have multiplied accordingly.

The proliferation and instability of terminologies poses a challenge to compilers and publishers of technical dictionaries which they cannot take up with much hope for unqualified success, and obviously none of ever achieving finality.

The 'General Explanations' introducing the first volume of the *Oxford English Dictionary* in 1884 carefully pointed out that 'the circle of the English language has a well-defined centre but no discernible circumference'. The main portent of this warning is still as valid as ever.

Narrowing down this same point to that of the language of science, the first volume of the *Supplement to the Oxford Dictionary** published in 1972 is even more explicit: 'Lexicographers are now confronted with the problem of treating the vocabularies of subjects that are changing at a rate and on a scale not hitherto known. The complexity of many scientific subjects is such too that it is no longer possible to define all the terms in a manner that is comprehensible to the educated layman.'

The educated layman need not feel unduly embarrassed. The scientist and technologist of today, whose work may be confined to narrow channels of specialisation is just as often disorientated in the terminological jungle of neighbouring fields as would be the layman.

So whilst the demand for reliable specialised technical dictionaries continues to be more and more pressing, the difficulties of satisfying that demand are considerable. Photographic technologies abound in these difficulties, probably as much as any other. Photography as a medium of recording, measurement and communication has invaded most fields of science, technology and industry and so in turn has been affected by their language. This process

* *Supplement to the Oxford English Dictionary* (1972) quoted by permission of The Clarendon Press Oxford.

not only enriched its own vocabulary, but in many cases shaded and blurred some of it.

Such a tortuous and volatile problem in lexicography could adequately be met in one of two ways—either by a formidable committee of experts or by an individual compiler of exceptional qualifications, experience and literacy. Both of these courses have disadvantages of their own.

The first working method would be inevitably slowed down by a lengthy interchange of ideas.

The second—the individual approach—might encounter occasional criticisms if and when its formulations were not supported by a broad consensus of opinion.

Yet the latter course not only seemed vastly preferable, because of D. A. Spencer's unique authority and persistence of purpose, but also proved to be remarkably effective, as he completed the work in less than five years—a feat which no complex editorial body could have been expected to accomplish. The resulting time gained cannot fail to benefit those consulting this Dictionary who will, alas, always be similarly disadvantaged by the superior momentum of change as its producers were conscious of being, from the outset.

Thus the outcome of D. A. Spencer's labours cannot possibly claim to be an end, but it can confidently serve as a reasonable beginning. Its usefulness in the long run will greatly depend on its very users, whose co-operation in terms of critical comments and suggestions for additional entries will be gratefully received by the compiler and publishers alike.

A.K-K.

Introduction

‘THE WHITE RABBIT PUT ON HIS SPECTACLES.
“WHERE SHALL I BEGIN PLEASE, YOUR MAJESTY,”
HE ASKED. “BEGIN AT THE BEGINNING” SAID
THE KING GRAVELY, “AND GO ON TILL YOU
COME TO THE END, THEN STOP!”’

Alice in Wonderland

In Dr. Samuel Johnson's famous dictionary he defined a lexicographer as 'a writer of dictionaries, a harmless drudge'. The drudgery I now know all about, but is a thing of the past which can be forgotten. It is the 'harmless' aspect that must give any compiler of a technical dictionary continuous mild uneasiness, since such chickens as come home to roost inevitably squawk too late to enable corrections to be made before going to print. As a consequence, the introductory prefaces to such works are typically more or less disguised apologies for regrettable omissions or commissions. It is in the hope of disarming conscientious reviewers and saving unnecessary correspondence that, within the hushed seclusion of this introduction, I attempt answers to such criticisms as I can anticipate.

Our prime objective in undertaking the compilation was to assist young newcomers, to any branch of photographic science technology and their applications, to grasp the meaning of the frequently used but specialised terms in the particular field they are entering and whose significance writers in that field tend to take for granted. Secondly, to assist cross-fertilization by helping workers in one field to acquire at least a basic understanding of the relevant terminology used in other fields of present or potential interest.

The reference to 'young' technicians is deliberate since photography as we know it today was largely based on the discoveries and inventions of young men. Thus, at the time they made their basic contributions, the ages of Young, Maxwell, Du Hauron, Vogel, Traube, Schinzel, Fischer, Mannes and Godowsky, from whose genius came the first practical systems of colour photography, ranged from seventeen to the early thirties with an average age of about twenty-six years.

How comprehensive a dictionary with the present title should be is an arbitrary decision and the compiler of a

single volume version of even a single field of science or technology is faced with the same dilemma as overnight visitors to Procrustes. Some parts he'd like to keep must go.

Accordingly, since excellent textbooks and works of reference covering all aspects of photography as a conventional picture-maker are available, many of the terms dealt with therein have been omitted on the assumption that technicians consulting the present work are less concerned with this—the familiar tip of the iceberg—than with those applications of photographic technology in its many newer forms which, as the handmaiden and recording angel of scientific research, industry and commerce are making vital contributions to mankind's progress towards Utopia—or possibly ultimate chaos.

Already contributions from fields such as electronics, electrostatics, magnetism, solid state physics, dye, diazo and polymer chemistry have resulted in advances in the methods and applications of image recording undreamt of at the time when photography with raw materials based on silver salts, traces of dyes, and the by-products of animal hides and bones began its spectacular growth to a major, world-wide industry. And who knows? By the end of this century perhaps the only current features remaining on even the amateur's snapshot cameras will be its lens and light-tight body.

Meanwhile space considerations also dictated an arbitrary selection of trade names for equipment and processes. Only relatively few of the thousands of modern lenses, hundreds of types of cameras and processes could be included. Such inclusions were therefore limited, in the main, to those appearing to the compiler or his advisers to be pioneering examples of particular types.

Less forgivable than omissions are errors, since a dictionary is typically consulted for the meaning or spelling of unfamiliar terms.

I used to get mild amusement out of the occasional inadequate or misleading definitions in some well-known dictionaries such as, for example, 'Radiology—The science of radio-active materials'.

This amusement changed to alarm when I found that the light vein in which I had undertaken to compile a dictionary myself had suddenly turned varicose! (As Dr. Johnson once said 'Everyone knows what light is—the difficulty is to say *what* it is'.)

Enlightenment is not helped by the fact that terms in all branches of technology proliferate faster than techniques. (In the thirty years following its first publication, Selwyn's 'amplitude reduction factor' acquired from other sources about twenty different names and symbols before it settled down to 'optical transfer function' in the case of lenses and 'modulation transfer function' when referring to a whole reproduction system.)

Then again the differences of opinion as regards the correct spelling for some terms. English is a language that is perpetually being pushed about and in so far as the Americans are the chief pushers, I personally applaud their efforts at rationalising its spelling.

The sole function of words is to communicate just as the

sole function of a dynamo is to generate electricity. To insist that the correct spelling of English words demands retention of the vestigial remnants of their ancient origin seems as pointless to me as it would be to insist that a piece of amber should form a part of a modern dynamo. Spatial frequency is not frequency in spate but in space and the knowledge that 'spatial' derives from the Latin 'spatium' does not clarify communication. If you think it does, should not the Americans be exploring spate rather than space?

In this increasingly complex civilisation of ours when children have so much more to cram into their heads during their receptive years, why clutter up their minds, fog their memories and waste precious school hours by complicating the learning of a vital means of communication?

Perhaps when the generation of infants being taught by Pitman's Initial Teaching Alphabet reaches the teenager stage and want some issue to revolt about, as an excuse for releasing their animal spirits by throwing stones rather than pitching baseballs or kicking footballs, their placards will demand that the Anglo-American language forgets its etymological background and adopts phonetically correct spelling.

Meanwhile my arguments with sub-editors over 'flam-mable' versus 'inflammable', 'gelatin' versus 'gelatine' etc. ended, in the case of -ise versus -ize endings to words such as Polarize in a compromise—sorry, compromise, whereby I was permitted to indicate the etymologically and phonetically correct -ize endings as an addition to the title of the first item in groups of terms with such endings. (Authors are notoriously dutiful and childlike as publishers know to their cost.)

Fortunately anomalies in the spelling of some terms are unlikely to confuse the users of this dictionary, and they may also be willing to overlook the occasional attribution of some invention or discovery to the wrong people. I have given what seems to be the majority view and would remind those who disagree that Isaac Newton's modest disclaimer, 'If I have seen further than other men it is because I have stood on the shoulders of giants' is generally applicable to other discoverers.

To avoid major errors in fields with which I am only superficially acquainted, I found that Newton's technique worked admirably in every case where the intellectual giants I consulted all agreed to stand still and all looked in the same direction while I balanced on their shoulders. Only once or twice did the method let me down when the giants moved apart and I dropped to the ground as befogged as before. The most memorable example occurred when I read in a technical but non-photographic journal a brief description of an intriguing technique which the author suggested should have potential usefulness in applied photography.

I drafted an item and submitted it to a technical expert who said the system could not possibly work and gave his reasons. I sent my draft with the expert's comment on it to the author of the article, who said my draft was a correct summary of the technique which certainly worked as

described. I then sent it to a third expert who said it might work but 'only if—'; so I sent it to a fourth who said The "—if" was nonsense and of course it would work providing I replaced that "—if" by an entirely different "—if" which he drafted for me. So I returned the comments (names omitted) to the original author who crossed out both 'ifs' and suggested I consult a fifth, who said he had no direct knowledge of the technique and referred me to a sixth who, he said, would know all about it—but he didn't; so I dropped the item.

I was much more fortunate in the other cases and am staggered at the patient help expert friends, erstwhile colleagues and strangers known only to me by name have so willingly supplied. Some of them wrote three, four and five page essays of explanation to justify modifications they made to my drafts, often supplying alternative, improved versions. (One of them spent a day in the patent office library to help get a single item into unambiguous form—in a field in which he is an authority.)

After reading the acknowledgements of my indebtedness listed on the following pages—and if you are still with me—you may well conclude that my own contribution to the dictionary was the ability to make myself a thorough nuisance to a lot of very helpful and tolerant people.

D.A.S.

'EXPLANATIONS TAKE SUCH A DREADFUL TIME'
SAID THE GRYPHON IN AN IMPATIENT TONE.

Alice in Wonderland

Acknowledgements

I am shortly going to enjoy making a bonfire of the three large suitcases of notes and drafts of the MSS but I am keeping the correspondence with the following on my permanent files as a reminder—should that ever be necessary—of the warm glows their help brought to the cold feet I periodically acquired during the five years of gestation.

Space precludes individual acknowledgement to the many people who helped me verbally with an isolated item but I must make such acknowledgements to the following starting with my debt to Mr. Andor Kraszna-Krausz, Hon. F.B.K.S.T.S., F.R.P.S., who, having invited me to compile this dictionary and set out its objectives, placed the whole of his Focal Library and the invaluable Focal Encyclopedias of Photography, and of Film and Television Techniques at my disposal. Thereafter he supplied the experienced and friendly advice, active help and continuous encouragement without which the assignment would never have been completed.

Holding my other hand was Mr. L. A. Mannheim, M.A. (Oxon) who went through the first draft item by item making constructive comments, suggesting new items, supplying or completely rewriting some, and querying others. Of course we did not always agree—no one is a monster of omniscience—but I like to think that, on occasion, we learned from each other. I certainly did from him.

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Quoting their names does not necessarily signify their approval of my condensed interpretations of the information they supplied to me.

In addition I am indebted to the following expert friends who either amplified the drafts of the appendices or supplied the greater part of them; Mr. P. Rolls for help with A. (Electromagnetic Spectrum) and amplification of B. (Symbols and abbreviations); Professor W. F. Berg for supplying C. (Photographic effects); Professor R. W. G. Hunt and Eastman Kodak for supplying D. (Nomograms); and Miss M. D. Gauntlett, B.Sc. for the basis of F, the Bibliography listing texts and journals in which extended treatment of the majority of the subjects itemised in this dictionary will be found.

Finally my compliments and thanks to the back room boys and girls of Focal Press including Mr. L. Gaunt whose sub-editing resulted in many simplifications in presentation despite some cordial disagreement over details; Mr. P. Poynter who converted diagrams from Focal Press texts or my sketches into suitably compact forms, and to Miss F. Head, Miss G. Simon and Mr. I. MacFarlane who have so cheerfully helped me with the day-to-day problems that beset a compiler working at considerable distance from his publishers.

Notes on Using this Dictionary

Word order

1. Typically the conventional 'noun first' order is used but terms consisting of two or more words of apparently equal importance and normally used together are listed under both, the shorter definition carrying a cross reference to the fuller version. Thus 'Highlight mask' carries a cross reference to 'mask, highlight' in 'M' where all mask terms are arranged in the alphabetical order of the qualifying word.

2. In the literature inconsistencies prevail as regards the use or non-use of hypens between the words of some compound terms. As far as possible the dictionary follows what appears to be the current fashion but such terms are not cross referenced since the alternative placings will be found in the neighbourhood of one or the other form.

Cross References and ▷

These are printed in *italic* throughout the book but in the text are confined to those occasions when it seems likely to be helpful. The symbol ▷ at the end of items indicates cross references to either a fuller definition, additional relevant information or a related subject.

Abbreviations and Symbols

For the meaning of initial letter abbreviations occurring in some text items see Appendix B page 696. This also contains lists of symbols for units used in the text as well as others occurring elsewhere in the relevant literature and guidance to the S.I. preferred method of presentation (the use of Roman and *italic* capitals, lower case, and full stops).

Trade Names

These are indicated by capital initial letters.

Terminology

The familiar meaning of terms such as 'tube', 'noise', 'filter', 'wedge', etc. is assumed to be understood, only the specialised meanings acquired in photographic technologies being given.

The terms 'cine' and 'cinematography' are generally used in an all-embracing sense whereas 'motion picture' is confined to the production techniques used in making films for projection in cinema theatres or via television.

The difference in the use of the terms 'graphic arts' and 'photomechanical reproduction' are defined in the text under these titles.

Diagrams

Some dimensions in the diagrams have been exaggerated for clarity—the thickness of coatings on sensitised materials and printing surfaces for example. Apparatus diagrams often illustrate only one of several different forms used for the purpose described in the item. The user is referred to the appropriate section of Appendix F (Bibliography) for texts in which fuller specifications and explanations can be found. To save unnecessary paper chases through the text some diagrams are repeated alongside widely separated synonymous terms.

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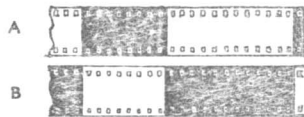
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A

A and B printing

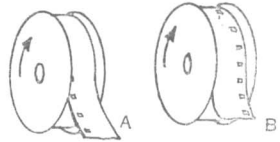
Method of printing cine film which enables optical effects, cross cuts, etc., to be inserted into the release print without using splices. The edited master negative (or reversal positive) shots are not joined in sequence on one roll but distributed between two rolls (A and B) which are made of equal length by splicing in black leader wherever A or B is not to print. The two rolls are then printed onto one film.



A and B printing.

A and B winding

Alternative methods of reeling up cine film perforated down one side only. With the emulsion side upward and the film unwinding clockwise, the perforated edge is towards (A winding) or away from (B winding) the observer.



16 mm sound film windings with emulsion side in.

A quality glass

Glass sheets of *optical flat* quality used for surface silvered mirrors in optical systems, for mounting gelatin filters used for *colour separation* and multi filtering techniques where exact registration of superimposed images is essential and in long focus and wide aperture lens work when the finest possible definition is required.

▷ *MP quality glass; T quality glass*

abaxial

Term denoting points off the *axis* of an optical system.

Abbe number

A number in the range 20 to 70 which is a measure of extent to which a transparent medium such as glass refracts light of different wavelengths to different extents (E. Abbe 1840-1905). This number, also called the '*v-value*', is the ratio

$$\frac{n_F - n_C}{n_d - 1}$$

where n_F and n_C are the refractive indices for the *F* (cyan) and *C* (red) *Fraunhofer lines* in the spectrum of hydrogen and n_d for the *d* (yellow) line of helium.

▷ *Dispersive power; Optical glass; Appendix F.2 (Clerc) and F.4*

aberration

Any inherent deficiency of a lens or optical system which is responsible for imperfections in the shape or sharpness of the image as a result of failure to image a point or a straight line as such or an angle as an equal angle. The various forms of aberration can be reduced but not completely eliminated by assembling a lens system from a number of different elements of compensating characteristics or by *figuring* the lens surfaces.

▷ *Alate; Astigmatism; Chromatic aberrations; Curvature of field; Curvilinear distortion; Decentration aberrations; Distortion; Higher order aberrations; Seidel aberrations; Sphero-chromatism*

aberration patch

The spreading and resultant shape of an image point corresponding to an object point or *point source*; caused by lens *aberrations*.

▷ *Airy disc*

abnormal pair

Pair of lens components which, in combination, possess a refractive index which varies in the opposite direction to the *dispersion*; either a high refractive index and a low dispersion or vice versa. Used to correct *astigmatism* in compound lenses.

abrasion marks

Marks or slight scratches on the surface of photographic materials caused by friction or abrasion from, for example, foreign particles trapped between adjacent layers of a spool of film. If made before exposure the resulting pressure marks may be light; after exposure and before processing they are either dark, or in the case of colour materials, coloured.

▷ *Pressure marks; Stress marks; Wet printing*

abscissa

On a *coordinate* graph, the horizontal axis of the graph or the horizontal distance of a point from the vertical line (the ordinate).

absolute

Pure (e.g. *absolute alcohol*); independent (e.g. *absolute zero* or zero K) as distinct from the arbitrary zeros of other temperature scales; not relative (e.g. *absolute colour*).

absolute alcohol

Ethyl alcohol virtually free from water. Also known as ethanol. Absorbs water vapour on exposure to the atmosphere.

absolute Angstrom unit

Unit of length used in very critical spectroscopic work. The term refers to the *Angstrom unit* as determined in a vacuum.

absolute depth of field

Arbitrary term sometimes used for the acceptable *depth of field* as determined by the *circle of confusion* which can be tolerated in lenses designed for different purposes. A circle of confusion of 0.1 mm which is adequate for contact prints, for example, is unacceptable when making very big enlargements.

absolute temperature scale

Temperature scale based on the fundamental relations between heat and energy. The zero on this scale is not an arbitrary point such as that at which ice melts (*Celsius scale*) but the point at which all molecular movement which gives rise to heat ceases. Using the same units as the Celsius or *Centigrade* scale, the absolute zero point is -273.16°C —which in practice is taken as -273°C . Hence Celsius temperatures are converted to Absolute by adding 273. *Colour Temperatures* are expressed on the absolute scale which is normally known as the *Kelvin scale* and sometimes as the thermodynamic scale. (William Thomson, 1848; became Lord Kelvin 1892).

▷ *Black body; International Practical Temperature Scale*

absolute unit

Unit of a physical quantity typically adopted internationally and expressed in terms of the fundamental units of length, mass and time which may be expressed in cm/gram/second (CGS), foot/lb/second (FPS) or metre/kilogram/second (MKS). Some units are necessarily established on an arbitrary but internationally agreed basis, such as the *candela*.

▷ *SI units*

absolute zero

The temperature at which all molecular movement ceases, which is -273° Celsius or zero K.

▷ *Absolute temperature scale*

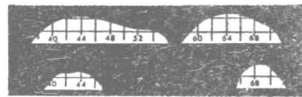
absorption

To take into the interior, light, gas or liquid. Absorbed light energy may be converted into heat or produce chemical or electrical changes in the absorbing molecules. Selective absorption from the range of wavelengths comprising white light produces coloured light. This term should not be confused with *adsorption*.

absorption band

Missing or attenuated region in the spectrum of light after its passage through a transparent medium, such as a colour filter or a dye coating on paper. When the incident light contains waves of frequency corresponding to the natural frequency of the bound electrons in the molecules of transparent substances, resonance occurs, the electrons vibrating with large amplitudes because they absorb the energy associated with that frequency. Light of this frequency is therefore missing from the emergent radiation. If the resulting absorption band is in the visual region the substance appears coloured.

▷ *Selective absorption*



Absorption bands in wedge spectrograms of two purple dyes.