Journal of the

Colour Group

Number 1 September, 1964

Chairman's Message

The Colour Group presents its new Journal to friends at home and abroad. The Group in its present independent form is three years old, following twenty-one years as part of the Physical Society. Both the membership and the activities are growing steadily, which shows that the Group has a real job to do. The systematic study of colour goes far beyond the traditional domain of the physicist, and there are many indications that both he and the chemist will find that they have to be familiar, not only with the work of the physiologist and the lighting engineer, but with that of the psychologist, educator and artist as well. It is remarkable how often communication between the physicist and the painter is seriously hampered by the fact that they still speak quite different languages.

Thanks to the Colour Group's many friends who have constantly put their services and their premises at our disposal, we are able to launch this Journal without any increase in members' subscriptions. Its purpose is to keep members in touch with each other and with other workers in the field, and to carry the informal spirit of the Group to those out of reach of London, where most of our meetings have hitherto been held. If it thrives as a healthy child should do, it may well require a different financial basis in the future. But for the present we only ask members to take their share of responsibility in helping our Editor, John Adams, to make it a lively medium for the exchange of information.

More and more people are asking for a working knowledge of the use and the effect of colour as well as for reliable methods of measurement and specification, and I can only hope that the Colour Group and its Journal may play a real part in helping to meet these needs.

MICHAEL WILSON.

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COLOUR NEWS

The " Colour News " sheet that has been issued to members periodically is a reprint from " Light and Lighting." If reference is made to any item in " Colour News," this should be to the appropriate page in " Light and Lighting." The references are as follows :

Colour News 1:

Light and Lighting. Vol. 55. (9). Sept. 1962. pp. 278-279.

Colour News 2:

Light and Lighting. Vol. 55. (12). Dec. 1962. pp. 373-374.

Colour News 3:

Light and Lighting. Vol. 56. (3). March 1963. p. 69.

Colour News 4:

Light and Lighting. Vol. 56. (7). July 1963. pp. 195-196.

Colour News 5:

Light and Lighting. Vol. 56. (9). Sept. 1963. pp. 261-264.

Colour News 6:

Light and Lighting. Vol. 57. (1). Jan. 1964. pp. 20-21.

Colour News 7:

Light and Lighting. Vol. 57. (4). April 1964. pp. 132-133.

Ciba Symposium

The Ciba Foundation arranged a symposium on the Physiology and Experimental Psychology of Colour Vision, under the chairmanship of Professor 0. E. Lowenstein, in London during July. Membership of the symposium was restricted, but the proceedings are to be published by J. and A. Churchill Ltd. in the spring of next year, as one of the books in the Ciba Foundation Symposium series.

Reports of Science Meetings by the Secretary

DEFECTIVE COLOUR VISION

The Second Extraordinary Science Meeting of The Colour Group was held as a Combined Meeting with the London Branch of the Society of Dyers and Colourists at Burlington House, London, on 6th March, 1964. The Chairman of the meeting was Mr. C. Barnett, of the Society of Dyers and Colourists, supported by Mr. M. H. Wilson. The Chairman introduced Mr. K. McLaren (Dyestuffs Division, I.C.I., Ltd.) to give his paper entitled " Defective Colour Vision—Its Nature and Diagnosis."

After indicating the extent to which anomalous colour vision occurs in the population, Mr. McLaren gave a detailed description of the types of anomaly and the way in which such vision differed from normal. He emphasised that most forms of anomaly introduced confusion of colours (loss of discrimination), but not a loss of sensitivity to the light itself.

Mr. McLaren illustrated his descriptions with coloured slides giving impressions of the spectrum as seen by various types of colour defective vision. Prot-anomalous and Deuteranomalous observers were shown to see certain parts of the spectrum less saturated than normal, and in Protanopes and Deuteranopes this was accentuated so that the spectrum was represented in yellow, white and blue. In these cases there was a sound basis for describing what the colour defective sees. In the case of Tritanomalous observers and Tritanopes and Tetratanopes tentative illustrations were given, but it was emphasised that these were based on questionable evidence.

Monochromats had no colour discrimination at all. Cone monochromats had normal vision except that they sawthe world as a panchromatic photographic film would. Rod monochromats, however, had no cone vision and, therefore, apart from complete absence of colour discrimination also had very severely limited vision in other respects.

In the second half of his lecture, Mr. McLaren described several methods available for detecting and classifying colour vision defects. The various types of anomaloscope provided a good test but were rather slow in use especially for industrial conditions.

The Ishihara card tests were well known and had been of tremendous value. They did, however, have several serious drawbacks. There were originally no tolerances allowing for the probable mistakes by normal observers. The revised

version (1960) made an attempt to allow for this. A serious objection, however, is that no strict specification of lighting is made. Bearing these defects in mind, Hardy, Rand and Ritler have devised a similar test but making use of the confusion of colours with grey found in colour defectives. They also produced their tests at three colour saturation levels and claimed that this enabled an estimate of the degree of anomaly to be made.

Finally, Mr. McLaren described the Farnsworth - Munsell " Hundred Hue Test," which was very useful as a hue discrimination test. He found that it was a very useful second test after the major anomalies had been detected by other tests. The fact that hue discrimination could be improved by training was illustrated by tests on trainee colour matchers. The meeting concluded with an interesting discussion.

COLOUR TELEVISION

Mr. I. Macwhirter (Thorn - A.E.I. Applications Laboratory) gave a lecture on " The Multiplexing of Colour Television Signals " to the Group in the Conference Suite of the Independent Television Authority's London Office on 11th March. Mr. Macwhirter began by saying that he had hoped to talk to the Group with a firm knowledge of the systems that would be used in European colour television in the coming years. Unfortunately, the recent conference on the subject had not reached agreement and had deferred final decisions until the Vienna meeting in 1965.

The existence of twelve million monochrome sets made the problem of colour multiplexing very difficult, since it must include something similar to a luminance signal. Mr. Macwhirter described the difficulties in detail and the influence of the likely coding systems, phosphors, signal bandwidths, receiver luminance levels and noise interference.

There had been considerable confusion over the " white point " for the colour balance of the receivers. Originally Ralph M. Evans had been approached, and had advised 3500/ to 4500/K and that the spread was less critical as the luminance increased. Despite this, in 1951 Source " C " was chosen as white point and since then the colour temperature of the white point of the average set has been rising. It was argued that it should be similar to monochrome colour, and that the public consistently demands " blue " images. Nowadaysthese may have a correlated colour temperature of 9000 to 11000/K.

Mr. Macwhirter ended his lecture with an interesting demonstration of the sort of colour television the public can expect at a typical cost of £250 per set. The SECAM coding system was used, and a series of colour films and video tape recordings was shown from the A.B.C. Teddington studio using the G.P.O. link to the I.T.A.

LAND

The title of Dr. L. Wheeler's lecture to the Group at Imperial College on 8th April was " Psychophysical Investigation of Induced Colours in Restricted Waveband Conditions." This dealt with the wide range of hue and chroma obtainable from projected patterns containing only red and tungsten light, and had been investigated

by direct comparison of the mixture colours with a Munsell Atlas. Dr. Wheeler surveyed the results he had already published (J.Opt.Soc.Amer. *53 (8).* 1963. 994-999), and presented new results in which the hue of an element of the pattern was related to the percentage of red light. Over a certain range of red content there were rapid changes in hue passing through what might be termed a neutral point. Dr. Wheeler gave demonstrations of the projected patterns he had used in his work.

The second part of the meeting was devoted to a discussion of proposals received by the Committee from the Research and Development Panel of the United Kingdom Automation Council. This is reported on page 7.

Meeting with Anders Hård

Mr. Anders Hard, Managing Director of ColorCenter AB and treasurer of the Swedish Colour Group, visited England in February 1964 in connection with the printing of a new Colour Atlas. Mr. Hard asked to meet members of the Colour Group and a meeting was arranged at Ilford House, Oxford Street, on 28th February. Unfortunately, owing to the very short notice the committee had of Mr. Hard's visit, it was not possible to let all the members of the Group know in advance of the meeting; however, eleven members were present to meet Mr. Hard and to hear his description of the work of the ColorCentre.

At the meeting Mr. Adams took the Chair, in the absence of Mr. Wilson. Mr. Hard first conveyed the greetings of the Swedish Colour Group to the Colour Group (Great Britain). He mentioned that the Swedish Colour Group was only formed on 15th January, 1964, with similar aims and objects to the British Group. He expressed the hope that there would be co-operation and interchange of ideas between the two Groups in the future.

He explained that the ColorCenter was set up in 1962 by an association of paint manufacturers, to facilitate the spread of colour ideas and to provide an atlas based on a perceptual system of colour suitable essentially for use by architects.

The " Natural System of Colours " was first conceived by Ewald Hering and the Hesselgren Colour Atlas was based on it. Tryggve Johansson, about 1936, carried out much work on the Natural System. The work was not published, but the ColorCenter has discovered a compendium of his work and has used this as a basis for their work on the new Colour Atlas. The new Atlas is largely a renotation and extension of the Hesselgren Atlas.

In the Natural System of Colours, white, black, yellow, red, blue and green are considered to be independent, and act as the basic colours forming the " framework " of the Atlas. White andblack are not considered to be greys. Greys themselves have a similar relationship to white and black as does, say, orange to yellow and red. Mr. Hard described the methods by which the basic yellow, red, green and blue were determined. Observers were presented with a number of coloured chips and were asked to choose the chip which was truly yellow, that is neither greenish-yellow nor reddish-yellow.

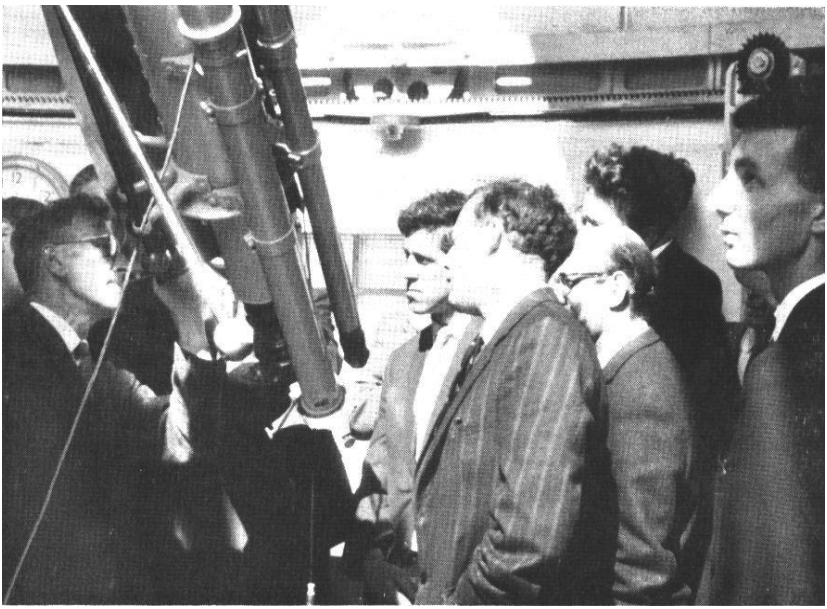
In the Atlas the basic chromatic colours are arrayed at equal intervals round the hue circle, i.e., at 90/ intervals. The Atlas is presented in the form of a set of constant hue charts. On each constant hue chart lightness increases vertically and saturation increases radially through one quadrant about the zero lightness point. The arrangement is such that " Strength " (approximately Chroma) increases with horizontal distance from the lightness axis similarly to the Munsell array.

In the discussion that followed Mr. Hard was asked if the choice of the basic chromatic colours was in any way predetermined by the method of presentation of chips. For example, there was the possibility that observers might have chosen the mid-point of the range of hues presented to them. Mr. Hard replied that he was confident that this was not so. Statisticians had been consulted on the tests to ensure that the results were free from any unintentional bias.

Dr. Crawford asked about the size of the colour chips and pointed out the effects of simultaneous colour contrast, particularly with respect to viewing distance. Mr. Hard accepted this criticism but felt that such effects would not invalidate the use of the Atlas when applied in its intended context.

There was finally a general discussion on the merits and otherwise of the choice of scales, particular attention being paid to the choice of a Saturation scale as opposed to one of Chroma.

F. J. B. W.



Members of the Colour Group examining the photoheliograph at the Royal Observatory during the summer visit (see next page)

Summer Visit

The warm red brick of Herstmonceux Castle contrasted with its surrounding fields and a hazy blue sky, when about twenty members of the Colour Group arrived for the summer visit. The Royal Greenwich Observatory is housed in modern buildings scattered over about a square mile of undulating country centred on the Castle. The grounds are wooded, but to the south there is an open view over Pevensey marshes to the sea, ten miles away.

Lunch was taken in the Castle and the tour started in the Time Department, about a quarter of a mile south-west of the Castle. The party was welcomed and told that there was little in the laboratories that was directly relevant to colour. This was accepted and the members promised to be interested in whatever was shown them. The explanation of the work of the Time Department centred on the comparisons that were made regularly between the time as determined astronomically and using crystal clocks at the observatory and as determined by other laboratories. Radio transmitting and receiving equipment allowed interchange of time signals with laboratories throughout the world.

The transit circle, in its white-painted hut, was visited next and there was an interesting discussion on the instrumental and other corrections needed when making visual observations that were to be converted to time determinations accurate to a few milliseconds.

The Equitorial Group, on a low hill and with its six large domes, is the most prominent building on the estate. Two of the telescopes were seen, the 28-inch refractor and the 36-inch Cassegrain reflector. The refractor is used for visual observation of double stars and photoelectric observation of intensity and colour of variable stars. The 36-inch telescope had a spectrograph attached and a spectogram that had been taken with it was examined by the party.

The photoheliographs were the last instruments to be visited. This was perhaps the most interesting part of the visit, as the instruments were in use at the time; the telescopes and transit circles being for night observations. The main work of this department is to keep a watch on the behaviour of the sun so that users of long-distance radio communications can be warned of impending fade-outs. More recently, operators of satellites and very high-flying aircraft have required warning of influxes of high energy particles from solar disturbances. The sunspot watch from which these warnings are derived is carried out using a four-inch telescope and photographs of the sun's disk are taken at intervals.

A lighter topic discussed was the treatment to be given to spiders which were required to spin webs of uniform diameter for use as cross wires—they (the spiders) must not be treated roughly. The result of a spider astray was seen on a routine photograph taken in 1907, which included a unique " spider sunspot," apparently caused by a spider on the plate at the moment of exposure. The observation on the day in question was not made at Greenwich, so we must not accuse the Royal Observatory of allowing a spider in its camera.

Observations of the solar corona in Hydrogen a light are also made in this department, and members were able to examine the equipment used.

The overall impression gained during the visit was of a well-equipped laboratory engaged in very long-term research and observation and also involved in current practical problems.

J. M.

A.U.K.A.C. Survey

In November 1963 the Secretary of the Colour Group received a letter from Mr. S. S. Carlisle, Chairman of the Research and Development Panel of the United Kingdom Automation Council. The letter stated that the panel was " examining the problem of colour measurement in industry with a view to defining needs for research and development into colour measurement technique." Enclosed with the letter was a report on colour measurement by Mr. S. P. Rose, in which the main difficulties of applying colour measurement to industrial problems were reviewed and, in particular, the need for more precise measurements was stressed. The Group was invited to comment on this report.

The letter and report were considered at a committee meeting of the Group and it was decided that the best course would be to invite Mr. Rose to address a meeting of the Colour Group, so that members could question him directly and put points of view. The meeting with Mr. Rose was arranged for 8th April, following the discussion on the paper by Dr. Wheeler.

At the meeting Mr. Rose indicated the ways in which he felt that colour measurement systems in industry were falling short of the requirements. He emphasised that there was at present considerable waste involved in the necessity to carry out colour matching stages at a distance from the production point. Methods which enabled suitable colour measurement to be made at the point of production would reduce this waste. In addition to this he felt that the build up of colour errors in a production process due to process variables necessitated high sensitivity colour measurement. At present each process variable is controlled to a tolerance based on the Colour Matcher's "just perceptible difference" limit. Consequently the final product is almost inevitably well outside the " just perceptible difference limit. Mr. Rose suggested that this difficulty implied that visual control could not be the basis except as the arbiter of the final product, and that instrumental methods much more sensitive than the eye would have to be devised for control of process variables. Mr. Rose then described a survey which had been carried out by the U.K.A.C. The letter and report received by the Colour Group had been circulated by the Scientific Instrument Research Association, of which Mr. Carlisle is director. Comments had been received from most of the Industrial Research Associations and also from a few other organisations. These comments had been summarised by Miss A. R. Bugden of S.I.R.A. Mr. Rose then called upon Miss Bugden to introduce her report.

A copy of the report had been received by the Group a few days before the meeting. It gives the problems of different industries as seen by their Research Associations, and also lists the research at present in progress at the Research Associations. The report is too long to be given in full in the Journal, but a summary of it will be included in the next issue of the Journal.

Opening the discussion Mr. Wilson asked Mr. Rose if he could give the Group a more specific aim on which collaboration with the U.K.A.C. could be based. In his reply Mr. Rose indicated that he felt the main problem was to devise a high sensitivity colour measuring instrument applicable to a large number of conditions of use.

Mr. Ellis of the Society of Dyers and Colourists emphasised the difficulties of instrumental control. The matter was mainly a subjective one. In industries

such as textile dyeing process variables were controlled by other physical and chemical methods and not colormetrically. Only the final stage involved the eye.

A further comment from a member of the Davidson and Hemmendinger Company emphasised that even a modest improvement in the present capabilities for industrial colour measurement would be welcome. Nevertheless, the phenomenon of metameric matches would always be a difficulty. The use of the C.I.E. diagram would be a questionable advantage, since it was so widely misunderstood.

Mr. Carnt said that the spread found in the colour vision properties of the population introduced difficulties in high accuracy colour control which could not be overcome when metameric matches were involved.

Mr. Chamberlin pointed out that his experiences of industrial colour measuring requirements showed that there was unlikely to be a single answer to all colour control problems.

Finally, the Chairman asked whether the members approved of a Working Party being set up, and this was agreed to.

F. J. B. W.
J. M. A.

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