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LIV. *Some Observations in reply to the Paper of Prof. C. G. Knott "On Swan's Prism Photometer, etc."* By O. LUMMER and E. BRODHUN*.

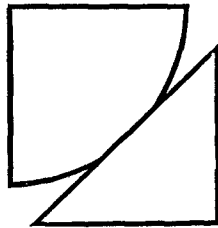
UNDER the title "On Swan's Prism-Photometer, commonly called Lummer and Brodhun's Photometer," Prof. C. G. Knott calls attention, in the January number of this periodical, to the fact that Swan had already, in 1859, "invented, described, constructed, and used" the photometer afterwards "re-invented" by us. The description given by Swan of his photometer-cube at that time is also reprinted.

May we be permitted to offer some observations correcting certain points in the above-named paper which seem to us to be misleading?

It is, first of all, certainly much to be regretted that this publication has been delayed until now, although Prof. Knott says the Swan photometer has been "familiar to all officially connected with the Edinburgh University Physical Laboratory for some years past."

Now, however, that Mr. Swan's precedence in the field is brought to our attention after this long interval, we desire to be among the first to acknowledge it. But the statement that the photometer which we introduced into the technical world is nothing more than a re-invention of Swan's photometer seems equally unfair to us.

Fig. 1.



On the basis of theoretical considerations we formulated the conditions necessary for a "Gleichheits-Photometer" of the greatest possible sensitiveness. Following these in our preliminary paper †, only that photometer-cube was described which fulfilled the theoretical requirements of an ideal "grease-spot" (fig. 1). This preliminary paper was followed, however, by our "Photometrische Untersuchungen" ‡, in which the advantages and disadvantages of the various possible

* Communicated by the Authors.

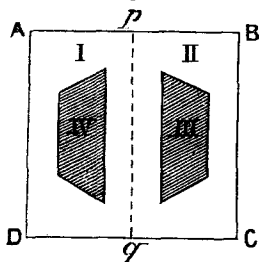
† *Zeitschrift f. Instrkde*, ix. pp. 23-25 (1889).

‡ *Ibid.* ix. pp. 41-50 (1889).

prism combinations were discussed. Among these is to be found the one which, as we now know, was invented by Swan forty-one years ago. This form was in our opinion, however, imperfect, and unsuited to technical requirements for the following reasons:—Apart from the fact that the balsam spot is not perfectly transparent, its edges do not afford that extreme sharpness which can be attained by ground surfaces, and they deteriorate by continually drying up. In consequence of this the balsam-spot cube, as well as some of the other prism-combinations perhaps superior to it, has never been recommended by us, and we doubt whether any considerable number have found their way into practical use in technical industry. Should photometers with balsam cubes, nevertheless, be now in use, they should of course be called Swan's photometers. But let us not forget that only with the most imperfect of all our described forms does the cube of Swan coincide, and the coincidence only extends to our "Gleichheit's" principle*.

But we did not stop with the "Gleichheits-Würfel;" we have also constructed a prism-combination which not only satisfies all the conditions of the "Gleichheits" principle, but also allows the more sensitive "contrast-principle" †, first

Fig. 2.



worked out by us, to be realized. The construction of this prism combination with the help of a sand-blast is described in our paper, "Photom. Untersuchungen I.," under cube No. 5. Its field has commonly the appearance indicated in fig. 2. The different field-sections (I.-IV.) are separated

* It may be remarked here that the cube form had been already used earlier by Fuchs for photometrical purposes, as mentioned in our paper. As criterion he used the disappearance of the interference-bands, which arise in the thin air-layer between the two prisms near the limit of total reflexion, and which are complementary to each other in reflected and refracted light.

† Photom. Untersuchungen, ii.: "Lichtmessung durch Schätzung gleicher Helligkeitsunterschiede (Kontrastphotometer)". *Zeitschrift f. Instrkde*, ix. pp. 461-465 (1889).

from each other by hair-sharp edges, which disappear completely, so that the whole field ABCD looks like a uniform, diffusely illuminated surface. But as soon as one introduces thin glass plates at proper points in front of the two illuminated sides of the cube the "principle of contrast" is added to the "principle of equality." The fields I. and II. are of uniform intensity, in consequence of which their separating-edge *pq* disappears; the fields III. and IV. have another intensity, but the difference between I. and IV. being the same as the difference between II. and III., they show equal contrast.

In the treatise* entitled "Die photometrischen Apparate der Reichsanstalt für den technischen Gebrauch," our photometer supplied with this "Gleichheits and Contrast-Würfel" is described and illustrated in the form in which it is constructed for technical use according to our designs by the Berlin firm, Franz Schmidt and Haensch. Whoever compares this photometer with Swan's prism-photometer will with an impartial judgment hardly agree with Prof. Knott when he exclaims, with reference to our photometer, "Let us now, who know its value, not forget that it is 'Swan's' photometer."

LV. *Thermal Radiation in Absolute Measure.* By J. T. BOTTOMLEY, M.A., D.Sc., F.R.S., and J. C. BEATTIE, D.Sc., F.R.S.E.†

THE experiments‡ described in the following paper form a continuation of researches on thermal radiation by one of the present authors, the results of which have been communicated to the Royal Society from time to time since 1884§. The main object of the present experiments was to push forward the inquiry as to the amount, and the relative quality,

* Photom. Untersuchungen, iv.: *Zeitschrift f. Instrkde*, xii. pp. 41-50 (1892).

† Communicated by Lord Kelvin; having been read before the Royal Society, Feb. 1, 1900.

‡ The experimental results of the paper were obtained two years ago. Various circumstances have prevented earlier publication; and it was originally intended to carry the investigation further before publishing. Want of opportunity, however, makes this difficult for the present; and we therefore deem it advisable to put our results on record just now, as they stand. The present investigation, as well as the former work referred to in the text above, has been assisted by grants from the Government Grant Fund.

§ "On Thermal Radiation in Absolute Measure," J. T. Bottomley, Roy. Soc. Proc. and Phil. Trans. 1884-1893.