DISCUSSION AND CORRESPONDENCE

DISTRIBUTION OF INTENSITY IN THE FOCAL SPOT OF AN X-RAY TUBE

IN a recent article on the apparent shape of X-ray lines, Mr. F. K. Richtmyer[1] describes experiments showing that the distribution of X-ray brightness over the focal spot of an X-ray tube is not uniform. He suggests that the non-uniformity is due to space charge effects and shape of target. Though the effect may be partly due to these causes, we have evidence that, at least in tubes using a Coolidge filament, the chief cause is quite different.

During our spectroscopic work, we have had occasion to investigate the distribution of intensity over the focal spot. For this purpose we took X-ray pin-hole photographs of the face of the target of a tube using a Coolidge filament. The plane of the target was normal to the cathode stream, and the photographs were taken in a direction as nearly normal to the face of the target as the shape of the tube would permit. Under these circumstances, if the exposures were so short that only the most intense rays were registered on the plate, the images of the focal spot were spiral in form and exactly what would be expected if the focal spot was a nearly orthogonal projection of the filament on the face of the target. In view of the small gaps between the spirals of the filament and the diameter of the wire, the sharpness of the images was surprising. When the photographs were taken through a narrow slit instead of a pin-hole, and in a direction making a small angle with the face of the target, the images contained striations running parallel to the jaws of the slit, exactly as was to be expected from the spiral nature of the focal spot. In using two very narrow slits in the manner described by Mr. Richtmyer, we find it of great advantage to have the line of slits fall on the most intense part of the focal spot as shown by these photographs.

In discussing the effect of slit width on the width of spectral lines, Mr. Richtmyer does not state how far his ionization chamber was from the crystal. Professor H. S. Uhler[2] has shown that, under certain rather rigorous conditions, when two very short slits of equal width are used, there is a portion of the monochromatic beam reflected from the crystal the width of which can not be greater than the width of the slits. This is only strictly true if the depth of penetration in the crystal is negligible and the crystal is a perfectly selective reflector. A finite depth of penetration in the crystal would tend to broaden the cross section of the portion considered, but probably by the same amount throughout its length. If there is a finite range of angles over which the crystal can reflect a given wave length, the reflected beam will be divergent even in Uhler's region of constant cross section. We have found that the Ka_1 line of silver reflected from a very perfect calcite crystal is broader when photographed in the portions of this region more remote from the crystal. Prof. Siegbahn[3] discusses the possibility of a finite range of reflection angles for a single wave length due to refraction in the crystal. Though we have not yet subjected the matter to a thorough investigation, the order of magnitude of this broadening is about what would be expected from the geometry of our spectrometer and the index of refraction of calcite, if this finite range of reflection angles really exists.

C. D. COOKSEY
D. COOKSEY

SLOANE PHYSICS LABORATORY,
YALE UNIVERSITY

[1] *Phys. Rev.*, 26, p. 727, Dec., 1925.

[2] *Phys. Rev.*, 11, p. 17, 1918.

CO BANDS

IN a recent article (*Astrophysical Journal*, 62, p. 145, 1925) I reported the discovery of three new band systems which I attributed to nitrogen and called the second negative and the fifth and seventh positive bands of nitrogen. I have recently received letters from Professor O. S. Duffendack, of the University of Michigan, and from Professor Raymond T. Birge, of the University of California, calling my attention to the fact that these band systems belong to carbon and are probably due to CO. Duffendack and Fox find them to appear very strongly in the spectra of low voltage arcs in CO and are measuring their excitation potentials. Birge points out that the seventh positive bands are a portion of the fourth positive bands of carbon that have recently been obtained as absorption bands of CO at ordinary temperatures by Leifson (*Astrophysical Journal*, in press), while the second negative bands fit into his scheme of energy levels for the ionized CO molecule (*Nature*, in press). The fifth positive bands have rather complicated fine structure and their exact origin is still in doubt.

The very close agreement of the vibrational shifts in these bands and in the first negative and second and fourth positive bands of nitrogen is apparent from tables III, VII and VIII of my article. In the first and second negative systems the frequency differences between corresponding vibrational levels differ only one half to one per cent., while in the second, fourth and fifth positive bands the frequency differences are identical within the limits of experimental error. This is further evidence in support of the view that the structure of the CO molecule is very similar to that of the N_2 molecule. From a

[3] Siegbahn, "The Spectroscopy of X-rays," English Trans. p. 23.

consideration of the masses of the nitrogen and CO molecules one would expect a difference of two per cent. for the vibrational shifts of corresponding systems. It would seem that the differences in the forces in the two molecules is such as to compensate for the differences in masses.

The presence of CO in my apparatus was probably due to its evolution from the nickel cylinder upon which the gauze was mounted. This nickel must have contained nickel carbonyl, which breaks down at high temperatures and yields CO. Facilities for the complete outgassing of this tube were not available.

D. C. DUNCAN

THE PENNSYLVANIA STATE COLLEGE

ANOTHER LUMINOUS SPIDER

A NOTE on "A Luminous Spider," published by me in SCIENCE, August 21, 1925, it seems has been copied in the London *Sphere,* and another observation has been reported in a letter from Mr. C. H. Bompas, Bishops Stratford, Herts, England, which reads:

I have read your note on a phosphorescent spider from Burma in the *Sphere.*

As you are presumably interested in such things you may like to know that I have seen such a spider at Shillong, in Assam.

The spider is truly phosphorescent and switches on its light when frightened. It is some time since I saw one, but my recollection is that the light came from six or eight spots under the abdomen.

The one I saw was in the middle of a bush and when approached or shaken glowed more brightly, no doubt as a means of defense.

The locality from which this second occurrence is reported is about one hundred miles from the place of my observation in Burma. While the observation differs in many respects, it is, I think, well worth recording.

BARNUM BROWN

AMERICAN MUSEUM OF
NATURAL HISTORY,
NEW YORK, N. Y.

THE METHODS OF THE FUNDAMENTALISTS

DR. KEEN'S experience with the "constructive memory" of the Rev. W. B. Riley, D.D. (SCIENCE, December 11, 1925, p. 543) just about matches a more recent one of my own with another important Fundamentalist.

My attention was called to an article, "The Bible and Evolution," in *The Herald of Christ's Kingdom* (September 15, 1925, p. 275) in which there appears a long quotation from Darwin's "Life," which examination proves to be made up by combining portions of two paragraphs that in Darwin's text (Vol. 1, pp. 277 and 282) stand four and one half pages apart. In this "quotation," moreover, Darwin's words (p. 282) "I deserve to be called a Theist" appear as "I deserved to be called an atheist"—and the usual moral is drawn.

I wrote the editors of *The Herald of Christ's Kingdom,* setting forth these facts, with all the proper references. I also wrote that their article contains, along with this, a great many more similar oversights; and I offered, since they proposed to bring out a reprint of their "special evolution number," to send them a list of a dozen or twenty of these errors, which I agreed to check up carefully, provided they would agree not to reprint in their new edition any fact on my list which they themselves could not verify, and would withdraw the spurious quotation.

They rejected my offer. This is the sort of evidence that is now being presented to state legislators to get laws forbidding the teaching of evolution. Moreover, these people are not anywhere in the mountains of Tennessee, but at 177 Prospect Place, Brooklyn, New York.

E. T. BREWSTER

ANDOVER, MASSACHUSETTS

SCIENTIFIC BOOKS

Left-handedness. By BEAUFORT SIMS PARSON. New York, Macmillan, 1924. Pp. 185.

THE fundamental differences that determine right- and left-handedness have probably not been discovered by Mr. Parson, and yet his experimental results are very suggestive. He calls attention to the fact, so often observed, that right-handed persons are usually right-eyed. Ordinarily the right eye has better vision. This is usually the eye selected for monocular use with microscope or rifle. But the author points out a more important meaning of the term, right-eyedness, which is this.

If we fixate a distant object with both eyes, a near object gives us a double image. If, maintaining our fixation, we grasp the near object and so move it as to bring its image on the fovea, it is usually upon the fovea of the right eye that the image falls. This means that when we point to an object we place the pointing finger along the line of vision of the right eye. Were we to direct both eyes toward the finger, the right eye would remain stationary and the left would move. In this sense the right eye is dominant. In reaching for an object that casts double images, it is stimulation of the right eye that determines our movement.

As aiming is done along the right eye's line of vision, the right hand is more likely than the left to