12. It was voted that the summer meeting of the association for 1931 shall be held at Pasadena, probably in the third week of June, the hosts for the meeting being the California Institute of Technology, the Mount Wilson Observatory and the Huntington Library.

13. It was voted that the winter meeting of 1931–32 shall be held at New Orleans from Monday, December 28, 1931, to Saturday, January 2, 1932.

14. It was voted that the association looks with favor upon New Haven as the place of the summer meeting of 1932 and upon San Francisco as the place of the summer meeting of 1934.

15. The general plan for radio talks to be given from time to time under the auspices of the Association Press Service was approved, as presented by the director of the Press Service.

16. In response to a suggestion from the director of the Press Service, Austin H. Clark, a special committee was named to consider the relations of the approaching New Orleans meeting to Latin America and to present plans for that aspect of the meeting. This special committee consists of Austin H. Clark (*chairman*), A. V. Kidder and Burton E. Livingston. It was empowered to add to its membership if additions seem desirable and was asked to present a report to the executive committee at its fall meeting, next October.

17. President Thomas H. Morgan was appointed to be the official representative of the American Association at the approaching semi-centennial of the University of Southern California, June 4 to 6, 1930.

18. Dr. Vernon Kellogg was appointed to be the official representative of the American Association at the tenth session of the Centenary of the Independence of Belgium, to be held at Brussels from June 28 to July 2, 1930.

19. A special committee, consisting of Austin H. Clark (*chairman*), Dayton C. Miller and Burton E. Livingston, was named to arrange for general and popular lectures for the approaching Cleveland meeting.

20. The appointment of Dr. H. W. Mountcastle as executive secretary of the Cleveland local committees was approved by the executive committee.

21. The permanent secretary asked that he be released from that office at as early a date as might be practicable, stating that he desired to devote more time and attention to his own field of plant physiology than would be possible in connection with his association duties, and a special committee, consisting of J. McK. Cattell, Edwin B. Wilson and Burton E. Livingston, was appointed to study the general administration of the association with respect to the retirement of the present permanent secretary and to report to the executive committee at its next meeting.

22. It was voted that the next meeting of the executive committee would occur at Washington on October 19, 1930.

BURTON E. LIVINGSTON,
Permanent Secretary

SPECIAL ARTICLES

THE STRUCTURE OF GLUTATHIONE

RECENTLY, clear evidence has come from two independent sources[1,2] that glutathione is a tripeptide derived from glutamic acid, cysteine and glycine. Twelve such dipeptides are possible. Six of these are eliminated by the fact[3,2] that the free amino group is that of glutamic acid.

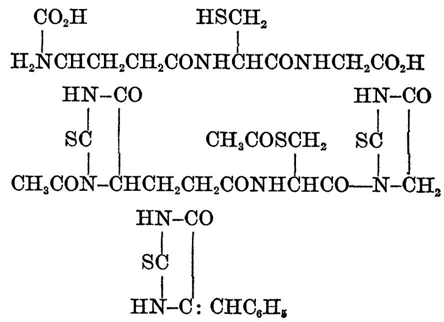
The fact that Hopkins[1] obtained glycylcysteine anhydride by boiling glutathione with water is extremely strong evidence that glycine and cysteine are directly linked, and this consideration eliminates the two structures[4] in which both carboxyl groups of glutamic acid are involved. A study of the products obtained on oxidation with hydrogen peroxide[3,2] strongly suggests that it is the γ-carboxyl of glutamic acid which is concerned in peptide formation. Thus glutathione is a peptide of unique type and must apparently be either (A) γ-glutamylglycylcysteine or (B) γ-glutamylcysteylglycine.

The proof that the substance is correctly represented by formula B has now been obtained by its condensation with ammonium thiocyanate in acetic anhydride, which yields a product (C), nearly insoluble in water, containing two thiohydantoin rings.

B

C

D



[1] F. G. Hopkins, *J. Biol. Chem.*, 84: 269–320, 1929.

[2] Kendall, McKenzie and Mason, *J. Biol. Chem.*, 84: 657–74, 1929.

[3] Quastel, Stewart and Tunnicliffe, *Biochem. J.*, 17: 586–92, 1923.

[4] Kendall's tentative choice (footnote 2) of one of these structures was made before this evidence was published.

Condensation of this thiohydantoin derivative with benzaldehyde and subsequent treatment with alkali yields benzal thiohydantoin (D), and the formation of this product demonstrates[5] the presence in the original peptide of a glycine group with free carboxyl. Other considerations, not yet ripe for discussion here, suggest that a free carboxyl group belonging to cysteine is not also present. The formation of two thiohydantoin rings in the first condensation product (C) would also confirm the existence of a free α-carboxyl group in the glutamic acid residue of glutathione.

It is interesting to note that structures A and B, with a slight preference for B, were chosen by Pirie and Pinhey[6] on the basis of dissociation constants deduced from results obtained in the titration of glutathione.

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TRANSMISSION CHANGES IN ULTRA-VIOLET GLASSES DURING HIGH TEMPERATURE EXPOSURE TO LIGHT

The recent keen interest in glasses transparent to ultra-violet radiation, and particularly the papers by Shrum, Patten and Smith[1] and by Stockbarger[2] in which are described certain phosphorescent and thermoluminescent properties of such glasses after exposure to ultra-violet light, suggest that some recent observations by the writers may be of interest to workers in this field.

It is well known that when some of these glasses are exposed to strong ultra-violet radiation, their transparency for the short wave-lengths is considerably decreased. It is also known that heating the solarized glasses restores them to their original condition.

In some recent experiments with several of the well-known brands the writers found that, if the specimens of glass were attached directly in contact with the hot tube of the mercury arc lamp and thus were kept at a high temperature (about 450° C.) during the ultra-violet exposure, there was no decrease in the short wave transmission, but instead, a marked increase. With one glass the shortest wave-length transmitted when new was 2535A. After solarization at atmospheric temperature, two feet from a quartz mercury arc, the transmitted spectrum was so shortened that 2620A was the low wave-length limit. When the glass, during exposure, was kept hot, the result was a very marked increase in transmission, so that wave-length 2460A was distinctly visible in the spectrogram of the transmitted radiation. This same result was obtained whether the glass had been previously solarized or not. In all cases the transmission spectra were photographed immediately after the ultra-violet exposure, the glass having cooled to room temperature. A condensed iron spark was used as the light source for testing the transmission.

All these specimens were then "annealed" in the dark at various temperatures, first at 200°, then successively at 300°, 350°, 400° and 450° C. After each annealing the glasses were cooled and their transmission spectra photographed. Even at 200° there was, in every case, indication of return toward the transmission of the original, new glass. This became more marked with increasing temperatures, until, after the 450° treatment, all had completely recovered the original condition.

On account of the fact that during the hot ultra-violet exposures there was only a line contact between the flat glass and the cylindrical lamp tube, the specimen was not uniformly heated. Examination (after cooling) with a low power polarizing microscope, between crossed nicols, showed severe strain in the glasses. This was also relieved by the subsequent annealing but had disappeared completely only after the last (450°) anneal.

Not all the ultra-violet glasses behaved in the way described. One in particular showed only a barely detectable decrease in transmission on low temperature exposure, and no change whatever after exposure in contact with the lamp tube.

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BOOKS RECEIVED

Hora, Sunder L. *An Aid to the Study of Hamilton Buchanan's "Gangetic Fishes."* Memoirs of the Indian Museum. Vol. IX, No. 4. Pp. (169–192). Plates (13–23). Published by the Director, Zoological Survey of India, Calcutta. 4s. 9d.

Moulton, Forest R. *Differential Equations.* Pp. xv + 395. Macmillan. $5.50.

Report on the Zoological Survey of India for the Years 1926 to 1929. Pp. lviii. Illustrated. Government of India, Central Publication Branch, Calcutta. 2s. 6d.

Sewell, R. B. Seymour. *The Copepoda of Indian Seas:* Calanoida. Memoirs of the Indian Museum. Vol. X, 1929. Pp. 221. 81 figures. Published by the Director, Zoological Survey of India, Calcutta. 13s. 9d.

Woodruff, Lorande L. *Foundations of Biology.* Fourth Edition. Pp. xvi + 501. 297 figures. Macmillan. $3.50.

[5] Schlack and Kumpf, *Zeitschr. für physiol. Chem.*, 154: 125–70, 1926.

[6] *J. Biol. Chem.*, 84: 332, 1929.

[1] *Trans. Roy. Soc. Canada*, [3] 22: 433, 1928.

[2] *Tech. Engineering News*, December, 1929.