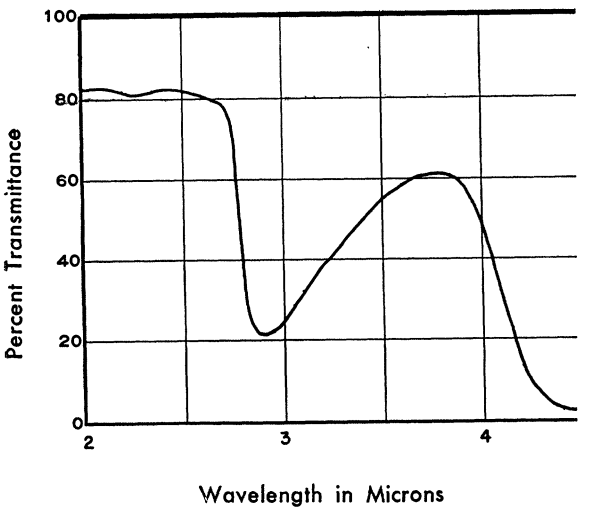

FIG. 1. Transmittance of 50% GeO_2-50% $Ti_3(PO_4)_4$ glass.

cause of the ease with which the melt can be cast, drawn, or pressed at temperatures of 1000 to 1300° C, a glass of this composition might be useful for infrared optical systems.

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The Enzymes of Uridine Polyphosphates

IN response to the recent "News and Notes" report in *Science* about 5-uridylic acid compounds (*1*), which covered work appearing as late as Nov. 1953, it might be of interest to add the following supplementary information. In 1952 we described the mode of action of a yeast enzyme that was found to catalyze a pyrophosphorolysis of uridine-diphosphoglucose (UDPG), forming uridine triphosphate (UTP) (*2*). In *Biochimica et Biophysica acta* (Warburg volume) a more detailed description of this type of enzyme and of the UDPG pyrophosphorolysis was presented (*3*). In a series of articles from our group (*4, 5*) the first accounts of the isolation, properties, and enzymic reactions of UTP were outlined. The new triphosphate was found to be much more acid stable than ATP. Moreover, it was found that the enzymology of UTP differs strikingly from that of ATP. Thus, ionophoretically purified ITP and chemically synthesized UTP (*6*) does not serve as a phosphoryl donor for creatine and glucose in the presence of the corresponding "kinases" (*6, 7*). However, the same authors have found that a newly discovered enzyme, nucleoside diphospho kinase, called "nudiki" (*6, 7*), catalyzes the transfer of the terminal phosphate groups between adenosine-, inosine-, or uridine polyphosphate compounds. In this way Berg and Joklik found that ionophorized inosine triphosphate ITP (*8*) and UTP need adenosine disphosphate (ADP) in order to serve as phosphoryl donors of glucose in enzyme systems with nudiki present and adenylate kinase absent.

Based on these facts, we have developed specific and quantitative micromethods for UTP and UDPG. Our studies of the effect of UTP on the myosin system are as yet unpublished. The writer has, together with Szent-Györgyi's group (*9*), studied the effect of heavy meromyosin on UTP. UTP was found to be dephosphorylated at a rate higher than ATP. Likewise Kielley and the author (*10*) have found that crystalline myosine catalyzes a rapid dephosphorylation of ionophorized UTP to UDP which is 3 to 6 times faster than that of ATP. The dephosphorylation of ATP to ADP is actually proceeding with an appreciable rate only in the initial phase (*10*). This peculiar difference in kinetics between UTP and ATP is under investigation. Some of these observations may have interesting bearings, since a group at the University of Lund recently has found that UTP occurs in muscle (*11*). The frequent occurrence of both triphosphates as well as of nudiki makes it difficult to interpret whether effects of UTP like contraction of muscle fibers or phosphorescence of firefly extracts are primary effects or secondary effects through the ATP system. UTP (synthetically as well as enzymatically made) is able to serve as a "uridyl" donor for α-glucose-1-phosphate (Cori-ester) in the enzymatic back-reaction catalyzed by the UDPG pyrophosphorylase (*4, 5*). In this peculiar reaction ATP is inactive. The equation, UTP + α-G-1-P ⇌ UDPG + PP, in which α-G-1-P signifies the Cori-ester and PP inorganic pyrophosphate, summarizes the aforementioned facts. By this reaction, plus the transphorylation from ATP, UDPG can be regenerated from the uridine diphosphate (UDP) formed in the novel types of disaccharide synthesis discovered by Luis Leloir and his group (*12, 13*).

In the most recent discovery in the series of brilliant research studies performed by Leloir and his colleagues, it was found that UDPG can serve as a glycosyl donor in a highly efficient synthesis of sucrose, catalyzed by an enzyme present in germinating peanuts and beans (*13*). This and the trehalose phosphate synthesis (*12*) constitute two examples in which nonreducing disaccharides are formed in an efficient fashion, using UDP-glucose as a glycosyl donor. Leloir and Cabib (*12*) found that the equilibrium, catalyzed by the sucrose forming enzyme, is displaced greatly in favor of the disaccharide (UDP-glucose + fructose ⇌ sucrose + UDP). This may imply that the ΔF of hydrolysis of the α-glucose-1-phosphate linkage of UDPG is higher than that of free Cori-ester by a factor of 1500 to 3000 calories at *p*H 7. It remains to be seen whether the only way by which the living cell can efficiently recharge UDP involves the uridyl-transferase plus the UDP-kinase. It should be added that our group, in collaboration with G. T. Mills, has found that uridyltransferases occur in the cell nuclei of rat liver and that these enzymes are active, not only on UDP-glucose, but also can form UTP from other UDP-glycosyl compounds (*14*). The recent studies by Rutter and

Hensen (*15*) at the University of Illinois indicate that UDPG may play a role in the formation of adaptive enzymes initiating galactose metabolism, a problem that was posed by the author of this article at the meeting last June at the McCollum-Pratt Institute, when discussing mechanism of enzyme action (*16*).

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References

1. *Science* **119**, 59 (1954).
2. H. M. Kalckar and E. Cutolo, Comm. II, Congr. Internat. du Biochim., Paris, 1952, p. 260.
3. H. M. Kalckar, *Biochem. Biophys. Acta* **12**, 250 (1953).
4. A. Munch-Petersen, H. M. Kalckar, E. Cutolo, and E. E. B. Smith, *Nature* **172**, 1036 (1953).
5. H. M. Kalckar, B. Braganca, and A. Munch-Petersen, *Nature* **172**, 1038 (1953).
6. P. Berg and W. K. Joklik, *Nature* **172**, 1008 (1953).
7. H. A. Krebs and R. Hems, *Biochem. Biophys. Acta* **12**, 172 (1953).
8. P. Berg and W. K. Joklik, methods to be published from the Institut for Cytofysiologi, Univ. of Copenhagen.
9. D. Geller, M. Borbiro, A. G. Szent-Györgyi, and H. M. Kalckar, unpublished studies, Woods Hole, 1953.
10. W. W. Kielley and H. M. Kalckar, unpublished studies, National Institutes of Health, 1954.
11. R. Bergkvist and A. Deutsch, *Acta Chem. Scand.* **7**, 1307 (1953).
12. L. F. Leloir and E. Cabib, *J. Amer. Chem. Soc.* **75**, 5445 (1953).
13. L. F. Leloir and C. E. Cardini, *J. Amer. Chem. Soc.* **75**, 6084–85 (1953).
14. E. E. B. Smith, A. Munch-Petersen, and G. T. Mills. *Nature* **172**, 1038 (1953).
15. W. J. Rutter and H. G. Hansen, *J. Biol. Chem.* **203**, 311 (1953).
16. H. M. Kalckar, "Mechanism of transglycosidations," in W. D. McElroy and B. Glass, Eds., *Mechanism of Enzyme Action* (Johns Hopkins Press, Baltimore, 1953–54), p. 675.

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Book Reviews

The World of Primitive Man. Paul Radin. Henry Schuman, New York, 1953. 370 pp. $5.00.

Dr. Radin always has approached the data of anthropology in his own unique manner, irrespective of the fashion of the moment, and he has seldom failed to be provocative. In this respect, his new volume is as characteristic of him as any of his earlier books and monographs, At a time when anthropologists and other social scientists have felt the need of being more discriminating in their vocabulary, Radin says: "I employ the words *culture, civilization,* and *society* interchangeably and also the phrases *primitive civilization* and *aboriginal civilization* interchangeably." And, when concepts used in the analysis of kinship systems and social organization are undergoing refinement, "classificatory" and "clan" are generalized according to his own conceptions. The latter, he writes (p. 193), "in spite of all the attacks that have been made upon its ubiquity, particularly by American anthropologists, is clearly the fundamental form the social-political organization of primitive people assumed."

The central problem that concerns the author is continuous with his discussion of *Primitive Man as Philosopher* (1927) and some passages of this earlier volume, with only minor changes, occur in *The World of Primitive Man.* For some reason or other, Radin entertains the notion that "few anthropologists, at bottom, have been willing to admit that primitive man was ever effectively guided by rationalistic or realistic considerations in the attainment of his goals" (p. 194). Without minimizing the role of magical beliefs and practices, he wants to demonstrate that there has been less interference "with the orderly processes of life" and processes of "rational and objective thinking" from these sources than has been supposed. In consequence, the author believes it can be shown that prior to, and apart from, the great civilizations (Egyptian, Babylonian, Indian, Chinese, and Greco-Roman) aboriginal civilizations developed at least three positive features that, in contrast with what we find characteristic of the former seem "at first blush" almost "semi-perfect." These are (p. 11): "the respect for the individual, irrespective of age or sex; the amazing degree of social and political integration achieved by them; and the existence there of a concept of personal security which transcends all governmental forms and all tribal and group interests and conflicts." In none of these aboriginal cultures, Radin says, "did those basic economic distortions and crises arise that have existed in all the major civilizations since 3000 B.C." And, in the primitive cultures, too, the myth of the after-life was more poorly developed, "there was no devaluation of life on earth"; on the contrary, "man's most insistent plea was that he be allowed to return to the earth." In other words (pp. 7–8), "instead of life on earth being regarded as an insignificant incident" as we find in the great civilizations, in the aboriginal cultures, "just the contrary held true; life in the after-world was so interpreted."

Radin espouses a stimulating thesis, but it is doubtful whether most anthropologists will be immediately convinced without more evidence than the author presents in this book. His ethnographic erudition is not in question, but he strides through the literature with seven-league boots, documenting his generalizations from a few selected cultures and quoting at length from source material. Nevertheless, the question remains whether his selected examples are representative of the primitive world at large and whether more systematic and detailed comparisons are not in order. Radin thinks primitive peoples have something to teach *us.* After quoting the reflections of the Eskimo Anarulungua when he stood atop a New York sky-