a single intrusive process—one that operated under very similar physical and chemical environments but was arrested in a different stage of development at each mountain. This concept suggested the desirability of mapping all the laccolithic mountains on the Colorado Plateaus to obtain working models illustrating the different stages in the igneous and mineralizing process.

These geologic problems fundamentally are physicochemical; but whereas the chemist deals with volumes that can be placed in a test tube, the geologist is confronted with volumes measurable in cubic miles. In the laccolithic mountains, the systems involve volumes ranging from 2½ to more than 9 mi^3. The spatial relationships, chronology, and changes in environment of such mountainous volumes are determined not by weights and measures but by surveying.

The mapping and related studies indicate that the earliest intrusions at each of the mountains were physically injected masses of diorite porphyry in the form of stocks and laccoliths. The degree of induration of shale at the contacts of these intrusions and the alteration of coal xenoliths incorporated in them indicate that the temperatures of the melts were only about 500° C. The physical injection of these intrusions produced large domes around the stocks and anticlines over the laccoliths that were pushed out radially from the stocks. Middle La Sal Mountain and several of the other laccolithic mountains on the Colorado Plateaus did not progress beyond this stage.

After about 5 mi^3 of diorite porphyry had been emplaced, the composition of the intrusive melt became monzonitic. Between 1 and 2 mi^3 of monzonite porphyry was intruded. Its temperature and mode of emplacement were approximately the same as for the diorite porphyry.

During the monzonite porphyry stage, there was little alteration of the wall rocks; apparently the dioritic and monzonitic intrusions not only were cool but contained only minor quantities of volatiles. At South La Sal Mountain the igneous activity ended with this stage.

At North La Sal Mountain, however, the igneous activity did not end with this stage. The monzonite porphyry there was followed by intrusion of a dike-swarm complex of dominantly syenitic rocks, a series of feldspathoidal dikes, and an irregular stock of soda syenite. The earliest of these syenitic intrusions seem to have been emplaced by physical injection, but the later ones melted and assimilated some of the adjacent wall rocks and caused other parts of the walls to recrystallize. The surrounding country rock, including many of the earlier intrusions, became shattered by radially arranged zones of vertically sheeted joints. Hydrothermal solutions escaping from the syenitic intrusions by way of these fissured zones deposited gold-bearing sulfides in them.

At this stage in the history of the North La Sal Mountain, the roof over the instrusions became breached, and explosion breccias developed in four major pipelike masses and in several lesser ones. These explosion breccias undoubtedly mark the roots of volcanoes. Associated with the breccias are intrusions of aegirine granite and soda rhyolite. These intrusions are much richer in potash than the earlier ones, and they contain the form of quartz that indicates a temperature about 600° C. This temperature is higher than that indicated for the diorite and monzonite porphyries, but when the breccia pipes were formed the pressure conditions drastically changed; breaching of the surface and resultant volcanism could have caused retrograde boiling. The igneous activity at North La Sal Mountain ended with this stage.

Radioactivity in the La Sal Mountain intrusions appears to be related to the magmatic differentiation sequence and not to the hydrothermal activity. The radon is least in the dioritic intrusions, greatest in the syenitic ones, and seemingly not affected by differences in degree of hydrothermal alteration. The other metals—copper, lead, zinc, selenium, and presumably the gold and silver—are of hydrothermal origin. They are mostly in the zones of vertically sheeted joints, and mostly in the most altered parts of those zones.

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Germanium Oxide-Titanium Phosphate Glass[1]

DURING the course of studies of various materials of possible use in delivering interstitial radiation by use of P-32 preparations, it was found that fusion of GeO_2 and $Ti_3(PO_4)_4$ produced glasslike melts. On increasing the Ti content, there was a marked decrease in the solubility, so that fusion of a mixture of 50% GeO_2-50% $Ti_3(PO_4)_4$ produced a stable glass, insoluble in water.

The $Ti_3(PO_4)_4$ was prepared by treating sirupy H_3PO_4 (95%) with concentrated HCl (37%) containing equivalent $TiCl_4$. The reaction mixture was heated to dryness, extracted with water, dried, ground to pass 100 mesh, and mixed with an equal weight of GeO_2. The resulting mixture was fused in an Alundum crucible at 1300° C (Pt-wound furnace). The viscosity at this temperature permitted easy pouring or drawing. A brown glass was produced that was annealed for 2 hr at 500 to 800° C and cooled with the furnace.

The brown color may have been due to some impurity in the $TiCl_4$ or to elemental Ge or Ti. The depth of the color increased as the Ti content was increased.

A study of the optical transmittance of a sample of 50% GeO_2-50% $Ti_3(PO_4)_4$, fused cast and annealed as previously indicated, is shown in Fig. 1 (data from the Naval Research Laboratory, Washington, D. C.). These findings show that in the range 0.5 to 2.7 microns, the transmittance is approximately 80%. Be-

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[1] The opinions or conclusions contained in this report are the author's and do not necessarily reflect the views or endorsement of the Navy Dept.

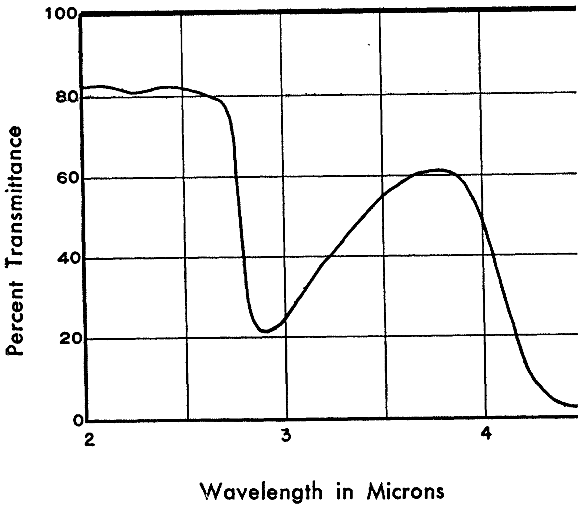

FIG. 1. Transmittance of 50% GeO_2-50% $Ti_3(PO_4)_4$ glass.

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, $\mathrm{UTP} + \alpha\text{-G-1-P} \rightleftharpoons \mathrm{UDPG} + \mathrm{PP}$, 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 ($\mathrm{UDP\text{-}glucose} + \mathrm{fructose} \rightleftharpoons \mathrm{sucrose} + \mathrm{UDP}$). 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