state are $\psi_1(0)\psi_2(\phi)$, etc. Since only one of the four functions contributes to the phenomenon we want to observe, we obtain the probability for that phenomenon immediately from the square of the amplitude.

The process mentioned in the beginning of this note is, however, not so simple, since, also, photons polarized perpendicularly to the plane of scattering contribute to the coincidences. If and *only if* the four functions used in the expansion in equation (1) represent an orthonormal set for the fourfold degenerate state, we can use equation (1) to calculate the cross section for the above-mentioned process. For this cross section, we can write:

$$\sigma = \Sigma a_k^2 \, \sigma_k, \qquad (2)$$

where the a_k represent the amplitudes of the functions $\psi_1(0)\psi_2(\phi)$, etc., and σ_k are the cross sections for the photons in the directions considered. For the function $\psi_1(\alpha)\psi_2(\beta)$, the cross section is, apart from a normalizing factor,

$$\sigma_k = (\gamma_1 - 2 \sin^2 \theta_1 \cos^2 \alpha) \; (\gamma_2 - 2 \sin^2 \theta_2 \cos^2 \beta), \qquad (3)$$

where the θ_i and γ_i have the same meaning as in the paper by SPH. From equations (1) to (3) we finally get, again apart from a normalizing factor

$$\sigma = \gamma_1 \gamma_2 - \gamma_1 \sin^2 \theta_2 - \gamma_2 \sin^2 \theta_1 + 2 \sin^2 \theta_1 \sin^2 \theta_2 \sin^2 \phi, \qquad (4)$$

which is identical with the result of SPH or Pryce and Ward.

If the four functions used in equation (1) had not been an orthonormal set, equation (2) should have included cross terms with $a_k a_m$, and we ought first to orthonormalize the set of functions used before applying an equation such as equation (2).

The fact that our choice, which is the natural, obvious choice makes it possible to use equation (2), corresponds to the remark of SPH that one *has* to resolve the polarizations of the photons in this particular way. It also corresponds to the fact that, only for this particular choice of the system of reference, the cross terms in SPH's equation (13) obtained by the usual perturbation theory vanish, as was also remarked by SPH.

The final cross section (4) may also be obtained by treating the scattering as consisting of two parts, an isotropic and an anisotropic part. One can then again use a formula, analogous to equation (2). If one chooses the right frame of reference, the result is the same.

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Formation of Itacolumite

Itacolumite, a stratified flexible sandstone, consists of symmetrically arranged rows of interlocking quartz crystals. In the study of its mode of formation, previous workers limited themselves in the main to general observations on field characteristics without considering the conditions essential to its formation. Again, extensive work has been carried out on the effect of fluxes upon the transition temperatures of quartz, though without reference to the problem under review.

A survey of the field observations shows that specimens taken from different localities vary both in their mineral associations and their degree of metamorphism. The rock matrix may, for example, comprise mica flakes along the bedding planes and as a joint between the quartz crystals (Itacolumi, Minas Geraes, Brazil—Schulz. *Bull. Soc. Geol. France,* 1834, 416; Gergens. *Neues Jahrb.*, 1841, 566; Zerrener and Von Humbolt. *Z. dtsch. geol. Ges.*, 1849, 484); it may consist of traces of muscovite and unevenly distributed clay (Delhi—Mügge. *Neues Jahrb.*, 1887, **1**, 195), sometimes soft felspathic materials form the matrix (Kaliàna, India—Falconer. *J. Soc. Bengal,* 1847, **6**, 240; Medlicott. *Rec. geol. Surv. India,* 1874, **7**, 30), and, again, calcium carbonate may be the cementing agent (Chàrli, Berar—Hughes, who quotes Fedden. *Mem. geol. Surv. India,* 1877, 16). These, together with Derby's observations (*Amer. J. Sci.*, 1884, **28**, 205) of weathered itacolumite as a purely quartz entity, illustrate the wide variety in composition.

The range in degree of metamorphism is equally marked, for the Brazilian and Kaliàna specimens have their mica flakes arranged with their longer axes parallel, suggesting considerable pressure and squeezing. Buschendorf (*Fort. Min. Krist. Pet.*, 1933, **17**, 407) has described the compression of individual quartz grains in the Kaliàna material—again signifying intense metamorphism, while the flexible sandstone discovered by Fedden, though exhibiting all the characteristics of itacolumite, contains calcium carbonate and shows virtually no metamorphism.

A study of the influence of fluxes upon the transition of amorphous silica to quartz goes to show that, though the mineral associations are diverse in type, they are of definite importance in the formation of itacolumite.

For quartz crystals to be formed, molecular mobility is essential and is, no doubt, attained either by fusion or by solvent action. With regard to fusion, the high temperatures involved may lead to nondifferentiation between the lower and higher forms of quartz, the additional formation of tridymite and cristobalite, and possibly the twisting and twinning of the quartz crystals. It has been shown, furthermore, that by this pyrogenic method, there is a tendency for silica to separate as a metastable, solid, vitreous mass when concentrations are high, cooling is rapid, and nuclei are absent. In contrast, the hydrothermal process, involving a variety of fluxes, actually facilitates the transition to quartz at much lower temperatures. It thus eliminates most of the anomalies cited.

Confining our attention to the latter, a number of experimenters have demonstrated this facility in the case of particular fluxes. The transition of amorphous silica to quartz occurs in the region of 870°. The temperature is depressed and the time factor lowered in the presence of water and solutions of lithium chloride-oxychloride. It is reduced to 750° with sodium or lithium tungstate, to 350°–380° with hydrofluoboric acid, and to 300° in the presence of sodium metasilicate and sodium chloride. Again, quartz has been obtained by heating silicic acid gel with potassium or sodium carbonate at 350°–390° and by the action of sodium carbonate and bicarbonate on aluminosilicate gels at 255°–355°.

The rhythmic deposition of quartz crystals would be brought about in a system specific to the Liesegang phenomenon—a system in which the constituents, acting as fluxes, influence the course of diffusion interaction, and transition. The itacolumite matrix is therefore indicative of the physical conditions prevailing during the formation of the mineral. Deviations from these conditions may be readily seen, as in the South Carolina deposits, where beds of itacolumite pass into stratified and even massive quartzite (Tuomey. *Report on the geology of South Carolina.* Columbia, 1848. Pp. 9, 78). The assumption that certain matrices are due to secondary depositions is doubtful in view of the fact that the metamorphism of the mineral associations closely follows that of the itacolumite itself.

Thus, while silicic acid gels give rise to minerals of the hydrated silica type (flint, opal, agate, etc.) and may be viewed as a transition of a secondary to a tertiary polymer of silicic acid, and while a silica-rich magma may lead eventually to the separation of massive quartzite, the formation of itacolumite is probably brought about by the action of various acidic substances on the basic fluxes, the fluxes serving as solvents of silica or in combination with it, the reaction taking place under conditions inherent to periodicity.

In the course of recent work (A. C. and M. Copisarow. *Nature, Lond.*, 1942, **149**, 413; 1946, **157**, 768; *J. Amer. chem. Soc.*, 1945, **67**, 1915; *Science*, 1946, **104**, 286), periodic formations of amorphous silica and silicic acid gel were obtained by the interaction of waterglass with acids. These rhythmic structures show a close analogy with itacolumite. Extending these experiments, therefore, to temperatures *above* the transition of amorphous silica to quartz, the conditions essential to the formation of itacolumite should be attained. In this case, the interband or embedding material would consist of the reaction product between the flux and the acidic or saline reagent.

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Effect of the Protein Content of the Diet on the Glomerular Filtration Rate of Young and Adult Rats

Inulin clearances in rats have been estimated by several authors. Their results, however, do not seem to agree with reference to (a) the relation between the rate of glomerular filtration and that of urine flow and (b) the mean value of the glomerular filtration rate. Some workers (S. E. Dicker and H. Heller. *J. Physiol.*, 1945, **103**, 449; **104**, 31; S. M. Friedman, J. R. Poley, and C. Friedman. *Amer. J. Physiol.*, 1947, **150**, 340; R. W. Lippman. *Amer. J. Physiol.*, 1947, **151**, 211) found that the glomerular filtration was independent of the urine flow, resembling in this respect adult man and the dog; others (E. Braun Menendez and H. Chiodi. *Rev. Soc. Arg. Biol.*, 1946, **22**, 314; M. Friedman. *Amer. J. Physiol.*, 1947, **148**, 387) claimed that the rate of glomerular filtration varied directly with the urine flow, as in rabbits.

Work on other species as well as on rats suggests at least two factors which may have operated in producing these confusing results. The rate of glomerular filtration is independent of that of urine flow in adult human beings, but correlated with the urine flow in infants (H. L. Barnett. *Proc. Soc. exp. Biol. Med.*, 1940, **44**, 654; R. F. A. Dean and R. A. McCance. *J. Physiol.*, 1947, **106**, 431). Also, there is a strong indication that nutritional factors influence the rate of glomerular filtration in animals (J. A. Shannon. *Amer. Rev. Physiol.*, 1942, **4**, 309; S. E. Dicker and H. Heller. *J. Physiol.*, 1945, **103**, 449; **104**, 31; S. E. Dicker. *Brit. J. Pharmacol.*, 1946, **1**, 194; S. E. Dicker, H. Heller, and T. F. Hewer. *Brit. J. exp. Path.*, 1946, **27**, 158).

The influence of age and diet on the glomerular filtration rate of rats was therefore investigated. Inulin clearances were estimated (a) in adolescent rats with body weights ranging from 101 to 150 gm and (b) in adult rats (weights, 275–320 gm) fed on a diet containing varying amounts (7, 14, 18, and 25%) of casein.

TABLE 1

	Plasma proteins (gm/100 ml)	Glomerular filtration rate (ml/100 gm/min)	r	b
Young rats (101.0–150 gm)	5.23	Correlated with urine flow	+0.778 ±0.073	+10.02
Adult rats (265.0–325.0 gm) 7% casein	5.84	Correlated with urine flow	+0.462 ±0.172	+ 6.39
Adult rats (270.0–345.0 gm) 14% casein	6.44	Correlated with urine flow	+0.415 ±0.166	+ 3.32
Adult rats (265.0–350.0 gm) 18% casein	6.83	0.43 ±0.009	−0.243 ±0.200	− 1.21
Adult rats (260.0–330.0 gm) 24% casein	7.33	0.76 ±0.035	−0.206 ±0.220	− 0.90

r = correlation coefficient between glomerular filtration rate and urine flow, b = regression coefficient. Values are means and standard error.

The results of the inulin clearance estimations in these series (Table 1) show clearly that, in adolescent rats as well as in adult rats fed on a diet low in casein, the rate of glomerular filtration was correlated with that of the urine flow, but that, in adult rats fed on a diet containing at least 18% casein, the rate of glomerular filtration was independent of the urine flow. It can also be seen that raising the amount of casein in the food, and thus the plasma protein level, produced an increase in the rate of glomerular filtration (Table 1).

It can thus be concluded that the disagreement between the authors interested in the kidney functions of the rat is only apparent. If the animal material is standardized, viz., due consideration is paid to the age and diet of the rats used, uniform results can be expected.

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