This compound is easily obtained in a pure condition crystallizing as colorless needles, and melting without decomposition at 221°. No reducing substance is formed by mild hydrolysis with hydrochloric acid. The compound is converted by intense hydrolysis into soluble products which easily reduce Fehling's solution. We are now engaged in the study of this interesting compound and are planning to utilize our new reaction for the synthesis of other sugar-pyrimidine and sugar-purine constructions (nucleosides), several of which are known to be formed by degradation of the nucleic acid molecule. A study of the pentose sugar-ribose will be incorporated into this research. We hope to be able to obtain data by synthetic methods, which will enable us to determine conclusively the nature of the sugar linkage in nucleosides, and also the position of attachment of the sugar in the pyrimidine and purine rings. The final results of our research will be published in the *Journal* of the American Chemical Society.[1]

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Guido E. Hilbert
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May 20, 1929

CRYSTALLINE PEPSIN

A crystalline material has been obtained which has the properties of the enzyme pepsin, in that it hydrolyzes gelatin, casein, egg albumin and edestin in acid solution and is rapidly inactivated by alkali or heat. The composition and activity remain constant through at least seven successive crystallizations and the crystals have constant solubility on repeated washings in dilute hydrochloric acid. There is evidence, therefore, that the material is a pure substance. It crystallizes in small hexagonal prisms from 0.01 to 0.10 mm long, sometimes separate and sometimes in clusters. It is insoluble in 0.001 M HCl (pH 3.0) and soluble in acid or alkali. It is precipitated by half saturation with ammonium sulfate, by copper salts, uranium acetate, lead acetate, trichloracetic acid and safranin and coagulates on boiling. It contains 14.5 per cent. nitrogen and has a diffusion coefficient in water at 8° C. of 0.085 cm^2 per day corresponding to a molecular weight of about ten thousand.

The activity is about 1:20,000 U. S. P. and is therefore less than some amorphous preparations.

[1] The authors have been able to make this preliminary report at this early date as a result of the kindly cooperation of Dr. P. A. Levene, of the Rockefeller Institute for Medical Research in New York City, who arranged for the microchemical analysis of our compound, and also that of Dr. C. H. Hudson, of the Hygienic Laboratory in Washington, D. C., who kindly furnished pure bromotetraacetyl-glucose for our preliminary work. (T. B. Johnson.)

The crystals were prepared from commercial[1] 1:10,000 pepsin by dialysis of a concentrated solution under pressure at pH 3.0 and 5° C. until a heavy precipitate forms. The suspension is then stirred at 37° C. for an hour, filtered, and the filtrate allowed to cool slowly. The crystals separate after about 24 hours and continue to form for several days. The yield amounts to one or two per cent. of the original material. Recrystallization is carried out by dissolving in dilute sodium bicarbonate at 37° C. and precipitating with dilute sulfuric acid.

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[1] Parke Davis pepsin, U. S. P. 1:10,000.

CONCERNING RETINAL PRESSURE IMAGES AND THEIR BROWNIAN-LIKE MOVEMENT

If the writer's own experience is any criterion, many persons in their youth discovered by chance that slight pressure continued for a short time on the eyeballs would elicit luminous manifestations in the subjective optical foreground which resolved themselves into flickering or vibrating mosaic-like designs of great intricacy and beauty. Kaleidoscopic in their variety, and in their symmetry, delicacy and intangibility more fascinating than snow crystals, they have perhaps served many of us as a pastime.

Upon closing the eyelids and pressing gently on the front of the eyes with the tips of the fingers, there begins, after a pause of a few seconds, a fantastic play of light and dark geometrical figures, the vividness of which is dependent among other factors upon the state of rest or fatigue of the visual elements. That is, in one experiment the bright divisions of the optical field may appear brighter and the dark divisions darker than in a second trial performed soon after when their dimness or the lack of contrast between them is such that the observer is unable to analyze or even to distinguish the pattern they compose. The sequence, however, in which the different kaleidoscopic designs follow one another relatively quickly is remarkably constant. But their individual units are never stationary; they oscillate or quiver with the rapidity and degree of excursion of Brownian motion.

I may be permitted to indicate a few of the conspicuous phases of the phenomenon. After the initial latent period, the dominating impression, as the light tracery crystallizes, so to speak, upon the shadowy foreground, is an involved checkerboard design consisting of thousands and thousands of facets. Indeed the regularity and symmetry with which these are arranged remains the basic plan despite the successive modifications in their form. From zone to zone the pattern may differ in the size, intensity and distribution of its units, and interspersed at definite intervals are dark gaps in which dancing circles of light soon appear. These introduce a rapid change in the mosaic, the numberless small divisions becoming circular or star-rayed, and then perhaps triangular, spreading out in parallel or complexly radiating rows like the ripples in fine sand produced by cross currents at the shore of a gently agitated body of water. Now and then there hovers the effect of a fine grating. At intervals the rings of light may become grouped in rosettes, or cluster concentrically around a center like the petals of a conventionalized compound flower. Finally this pageant of transient designs—ever vibrating—is transformed into a complicated and diaphanous web resembling exquisite lace, which persists for a while, then becomes hazy and gradually fades away.

When this luminous phenomenon is at the height of its distinctness, minute points of light and color, more brilliant and sparkling, may emerge to dot the field; all the colors of the spectrum are represented, but the blues, violets and purples predominate. These points may endure for some time after the mosaic and subsequent maze have vanished.

Often I have endeavored to sketch the phantasms, but because of their baffling complexity and animation, the pictures of them turned out to be too crude even to suggest their true configuration. That these phenomena can not be regarded as subjective creations, that is, as related to, if not synonymous with, visibly projected mental imagery or hallucinations, but as objective appearances arising in the eye is evidenced by the constancy with which they spring up under pressure, the constancy in the sequence of their metamorphoses, and the necessary lapse of some minutes before the experiment can be repeated. In other words, the physicochemical environment of the retina, disturbed by mechanical stimulation, must return to an unstable equilibrium before the next stimulus is able to bring about a recurrence of the phenomenon.

Any one who has studied the geometrical harmony of the pressure images in his own eyes and is familiar with the construction of the human retina, particularly with the disposal of the primary visual receptors, the rods and cones—as illustrated in the well-known drawing by Max Schultze—can not help bringing those images into relationship with these retinal cells. When he opens physiological text-books for confirmation of his observations and his interpretation of them, he is startled by an utter silence or at best by the scantiness of allusion to the interesting phenomenon. For it is perfectly obvious that because of the attention it compels among the curious, men have been aware of it since ancient times. And who can say but that many schematic devices and embellishments in the fine and applied arts and crafts did not hail from that delicately projected phantasmagoria? Diligent bibliographical search does reveal that there is a wider knowledge of it, though sporadic, and that the artistic temperament was aroused by it quite as much as the scientific mind.

It was Purkinje who, in his "Beobachtungen und Versuche zur Physiologie der Sinne" (1819, 1825), gave us the first detailed description of the patterns which the luminous manifestations assumed. Though his narrative is concerned largely with the "Lichtschattenfigur," obtained when the eye is alternately and rapidly illuminated and shaded—as occurs when one looks at a slowly revolving disk made up of light and dark segments—this checkerboard figure conforms essentially to that evoked by diffuse ocular pressure. In fact, to the writer it was a source of wonder at first, and then of satisfaction, how closely his own account of it tallied with Purkinje's picture of it, and with the descriptions given by other investigators, such as Czermak (1860), Houdin (1868), or of von Helmholtz ("Physiologische Optik," 1867, 1886–94) who were not cognizant of Purkinje's work at the time they made their own observations. This striking agreement in the narratives reaches even to the choice of words in the attempts to delineate correctly the elusive phenomenon. In the writer's judgment this is decisive proof that its display is not founded on subjective idiosyncrasy, as some observers seem to believe, but is a direct expression of the structural composition of the human retina.

Other investigators (Johannes Müller, 1826; A. Waller, 1849; Aubert, 1865; Novotny, 1868; Fick, 1879; Beaunis, 1881; E. Fuchs, 1881; Tscherning, 1891; Charpentier, 1891–1896; Sherman, 1897; Schwarz, 1902; F. Klein, 1905–1908; R. Stigler, 1906) have written about light images engendered by indirect mechanical irritation of the retina, but practically all descriptions pertain to an appearance different from the one delineated above. They deal for the most part with a relatively large luminous ring or halo that arises in the visual field opposite to a circumscribed area of pressure applied on the side of the eyeball. Aristotle was familiar with this phenomenon. In the eighteenth century reference is made to his observation by Isaac Newton (1706), D. Jurin (1738), Eichel (1774) and J. Elliot (1785). It is said (Marisi, 1852) that Cuvier considered it diagnostic of retinal sensibility. The term "phosphenes" to denote these luminous impressions is found for the first time in the work of Serre d'Uzés (1853). This observer and Masson (1854) discussed them in their bearing on the pathology of vision.

In a quotation, which I transcribe freely, Purkinje predicted, in a sense, the fate of some of his studies:

So long as an observation stands isolated in the domain of natural science, or has not been brought into relation with a more or less important experience or practical application which gives it rank or tangible character, it is always in danger of passing unheeded or sinking into oblivion; not until the unceasing search for knowledge unearths new objects on which it fits does it earn recognition and a secure place in science.

Neither the stir which Purkinje's findings made in his day nor the flattering but sincere eulogies which Goethe heaped upon the personality and genius of Purkinje sufficed to prevent the recession of those observations into obscurity.

In notes, which have reference to the phenomenon here considered, Goethe wrote in his journal or annals of 1821:

Turning now to scientific research, I will say that above all Purkinje's work on subjective vision excited me very much. I made notes of it, and intending to make use of them subsequently in my paper, I had a copy made of the accompanying plate. This arduous task was executed by the artist accurately and gladly, since he had previously been frightened by similar phenomena, but now, learning that they signified nothing abnormal or did not herald a pathological condition, he was much relieved.

Later, when Goethe discusses Purkinje's studies, we are informed that it was the noted copper engraver, Schwerdgeburth, of the court of Weimar, who had fears for his sight if not for his sanity. This artist himself had made sketches of the impressions as they appeared to him, which pictures Goethe preserved for comparison with Purkinje's.

Purkinje harassed himself hunting for the explanation of his "Lichtschattenfigur"; he teased apart the fibers of the dried crystalline lens, he examined the granules of the frozen vitreous humor, he investigated the retina microscopically, but all to no avail; its true causation stayed concealed. If he had known the existence and significance of the rods and cones, discovered by Huschke and Treviranus more than a decade later, I am certain he would not have hesitated to bring the facets of the luminous mosaic into relation with those retinal elements. It remained for Czermak to suggest that relationship. To-day, in spite of the objections that may be raised against this conception, we can still accept the light patterns induced by ocular pressure as a sublimated or ethereal image, as it were, of the retinal architecture. In part, the evidence has already been intimated above. The contention that the individual units of these scintillating mosaics can not be identified with the counterparts of the visual cells, because these are microscopic and beyond the normal range of naked vision, is no harder to refute, it seems to me, than it is to explain how the small surface area of the retina is able to grasp the forms of all the multitudinous and relatively gigantic objects in the external world stretching far to the horizon, and convey them to our conscious perception in their proper relation and magnitude.

If an apparently correct explanation has been offered as to the meaning of the retinal pressure images, such can not be said of the quivering movements of their innumerable facets. Their vibrations are independent of the periodicity of the pulse; they are neither synchronous with it, nor are they modified or accented by it. They are rapid and of exceedingly short amplitude. These characteristics lead the writer to place them in the category of Brownian motion. Is it the entire visual cell, or only a part of it—the photic material disseminated in its protoplasm—that executes the luminescent dance? If the suggestion embodied in this query is substantiated, it will be with a certain strange realization that here in our complicated organism is a place in which we can sense directly, so to say, the existence of our individual cells and to a limited degree their life.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SPRING MEETING OF THE EXECUTIVE COMMITTEE

THE regular spring meeting of the executive committee was held in the board room of the Cosmos Club, Washington, D. C., in two sessions, forenoon and afternoon, April 21. For the forenoon session President Millikan was in the chair, and for the afternoon session Chairman Cattell presided. The following members were present: Cattell, Compton, Curtiss, Kellogg, Lillie, Livingston, Millikan, Moulton, Wilson. Absentees were Johnston and Ward. The following items of business were transacted:

(1) The minutes of the last meeting of the committee were reported to have been approved by mail.

(2) The permanent secretary reported that more than 3,500 advance, prepaid orders for the *Proceedings* volume for 1925–29 (which will include the directory of members, with about 21,000 names) had been received by April 1. The prepublication price is $2.50 to those whose names occur in the directory; it will be $3.00 after publication. To those whose names are not in the directory the price is $4.00. With cloth binding the book costs $1.00 more in each