tion might seem to have supernatural connotations, to psychological tests in the field of perception and apperception, such as the Rorschach Technique and the Harvard Thematic Apperception Test.

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Meteor Trails on the Moon

In *Science* (1946, **104**, 448) there is a letter from James Bartlett, Jr., explaining his concept of what N. J. Giddings, of Riverside, California, saw and described as "flashes streaking across the moon." I should like to discuss briefly Mr. Bartlett's explanation and show not only that it is contradictory to simple facts that can be secured by careful observation of the new moon at twilight, but that his statement that the meteorite trails would be visible only with the dark surface of the moon as a background is quite in error.

First, the new moon, if observed carefully, will be found to show, up to the fifth or sixth day, the usual "earth shine" phenomenon; the side that is not directly illuminated by the sun is not entirely dark, but reflects secondarily light that has first been reflected from the earth. Thus, the "dark" portion of the moon is actually lighter than the surrounding sky, and if meteor trails were visible against the "earth shine" illuminated disc, they certainly could be seen against the surrounding darker sky.

Accordingly, Mr. Bartlett's statement that the meteor trails "would be visible for *just that portion of their path* which had the dark side as its background" is thought to be quite in error, as the "dark side" of the moon is at least no darker than any other nearby part of the sky and is usually somewhat lighter due to "earth shine." Thus, a meteor would, in theory at least, be no more visible over the moon's darkened disc than elsewhere in the sky and would possibly be less so, if of a very faint magnitude.

Whatever might be the true explanation of Giddings' observation, I feel Mr. Bartlett's theory, although ingenious, is fundamentally unsound.

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The communication from James C. Bartlett, Jr., concerning the projection of meteor trails on the moon (*Science*, 1946, **104**, 448) reopens the fascinating possibility originally observed and reported by N. J. Giddings (*Science*, 1946, **104**, 146).

However fascinating the original observation was, the reasoning followed by Bartlett is even more amazing. He says, in substance, that meteors entering the earth's atmosphere would not have been seen against the bright sky but, crossing the *dark* surface of the moon, would be visible.

How is this dark surface of the moon to shine darkly through the scattered atmospheric light which comprises the sky? Is this some new and visible manifestation of the "black light" we so often see headlined in the popular press? Bringing the dark portion of the crescent moon to this side of the sky so that it can be darker than the sky reminds one of the pictures of the hornéd moon with star embraced therein.

Records of previous observations of lunar flashes would be timely, as well as a written, brief, and "courteous discounting" by the authority first consulted by Giddings.

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On the Concepts of Mitosis

A lag exists between our concepts of mitosis as taught at the elementary and graduate levels and the picture as it has emerged in the last decade. The average biologist thinks of nucleolus and chromosomes as lying free and unoriented in the karyolymph and of the metaphase plate as the product of forces of attraction and repulsion between chromosomes and central bodies operating in a more or less uniform field.

For 10 years I have been analyzing the movements of nuclear chromatin in relation to the topography and movements of the cytoplasmic elements in the grasshopper follicle and onion-root tip meristem. Several important features have come to light:

(1) The centromere, and often the telomere regions, maintain association with the nuclear membrane throughout the interphase or "resting" condition.

(2) The nuclear membrane plays a role in the formation of the metaphase plate, which becomes a rough projection in one plane of the relative positions occupied by chromosomes at prometaphase.

(3) Heterochromatic regions are for the most part those associated with the nuclear and nucleolar membranes. Chromatin in the condensed state tends to be associated with these membranes. In fact, chromatin at all its levels of integration seems to be associated with the surfaces of structures of which it forms a part.

We may now superimpose upon the above the following established facts and current assumptions:

(4) The chromosomes in the interphase of rapidly dividing cells maintain their telophase polarity. Even in longer interphases, where the chromosomes shift positions considerably, this polarity is never wholly lost.

(5) The nucleolus is typically borne on definite loci of definite chromosomes.

(6) The centromere, telomere, and nucleolus-organizing regions are usually heterochromatic. Conversely, the bulk of heterochromatin is located in these regions. Centromere and telomere concentrations are known as chromocenters.

(7) Centromeres and telomeres have many properties in common.

(8) These regions are sensitive to external conditions.

(9) They are frequently associated with concentrations of cytoplasmic bodies.

(10) In many plant cells (e.g. *Allium*) they reflect cell polarity. The larger, usually more numerous proximal chromocenters are on the nuclear membrane in the region of the active division pole, and the smaller, less numerous distal chromocenters are located at the opposite, less active pole.

(11) The region just outside the nuclear membrane shows greater oxidation activity and higher concentration of ribose nucleic acid.

(12) Cytogenetic evidence from translocations suggests that heterochromatin and centromere regions exert a gradient of effect along the chromosome, manifest both in nucleic acid disturbances and genetic effects.

(13) The heterochromatic regions are thought to contain nonspecific *polygenes,* more or less cumulative and indeterminate in their effects, as opposed to the specific, saltational *oligogenes* of euchromatin.

(14) The heterochromatic regions are thought to be regions of nucleic acid synthesis.

(15) The constituents of nucleic acid are also constituents of the O/R-phosphorylation mechanisms preeminently concerned with energy metabolism.

From a synthesis of these facts, the following hypothesis may be derived:

(1) Heterochromatin as substance and the centromeres, telomeres, and nucleogenic regions as loci, are in some way concerned with transfers of energy and/or substance across the nuclear and nucleolar membranes. Painter (1945) suggests a heterochromatin $\longrightarrow$ nucleolus $\longrightarrow$ cytoplasm cycle; I believe the circuit (a) may include other elements than the ribose $\leftrightarrows$ desoxyribose cycle and (b) may, in some cases, proceed in the reverse direction. Heterochromatin would thus be "liaison chromatin."

(2) From their behavior and topography chromosomes appear to be lines of transfer of energy and/or substance traversing the distances between the heterochromatic junctions.

(3) The metaphase period of maximum chromatin condensation with its minimum of surface area may also be specialized for energy transfer. In view of (11), (14), and (15) above, the transactions may be those concerned with energy metabolism. Such function may be the common denominator of all pycnotic chromosomes and chromosome regions.

(4) The nonspecific, quantitatively indeterminate polygenes of heterochromatin may be nothing more than effective concentrations of the constituents of nucleic acid participating in energy metabolism.

(5) The strategic location and direct participation of heterochromatin in energy metabolism would explain many of its properties and functions, especially its connections with cytoplasmic metabolism, and its apparent pacemaking role in neoplasia and variegation.

In short, *the various forms which chromatin assumes, and the changes which it undergoes in the mitotic cycle, may be a shifting series of pathways along which transfers of energy and substance are taking place between chromosomes and karyolymph and between nucleus and cytoplasm.*

The topography of the cell would thus be visible reflection of its function as an energy transformer.

The above thesis, expanded into a more detailed hypothesis, will appear elsewhere at a future date.

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Book Reviews

***Longleaf pine*: *its use, ecology, regeneration, protection, growth, and management.* W. G. Wahlenberg. Washington, D. C.: Charles Lathrop Pack Forestry Foundation, in cooperation with the Forest Service, U. S. Dept. of Agriculture, 1946. Pp. xxii+429. (Illustrated.) $5.00.**

This is a concise and clearly presented synthesis of the voluminous empirical and fundamental information that has accumulated through years of research on the silviculture and management of one of America's most valuable forest trees. It should be of great service to practicing foresters, scientists, students, and teachers. The Introduction clearly defines the longleaf pine problems.

Part I gives a well-illustrated summarization of technical data on resources, commercial uses, and wood and pulping properties of the species. Major economic uses are naval stores, piles, poles, posts, ties, mine timbers, lumber, and pulpwood. Less than half of the volume of wood was utilized until the pulp mills began converting the tops into paper. In second-growth forests, the species is being gradually replaced by slash pine in the coastal areas.

Part II covers the ecology of the species, including such items as site, climate, soil moisture, and soil fertility. An entire chapter is devoted to the much-discussed role of fire in regeneration. The author cautiously concludes that fire is advantageous in five of six conditions that prevent successful natural regeneration.

Part III is a very fine assemblage of information relating to the role of seed production, soil fertility, seedling development, and seedbeds in natural and artificial regeneration. Again the author recognizes the essentiality of fire for regeneration. The importance of leaving seed trees on cutover areas is stressed.

Part IV evaluates the damage and losses caused by fire, insects, animals, and climate. Damage from insects and disease can be minimized by improvement cuttings and thinnings. Chapter 8 is devoted to an analysis of the fire situation in the longleaf pine region, including behavior of fires, effects of fire on stands, mortality, fire control, and protective burning. The author concludes that periodic, controlled burning is advantageous. Uncontrolled burning may reduce diameter and height growth by approximately 20 per cent.