More than 160 cultures of antagonists were thus isolated from soils, manures and composts.[3] These fungi were divided into nine groups on the basis of their taxonomic and physiologic relationships and were found to vary greatly in their capacity to produce antibacterial substances.

Of these antagonistic fungi, two species of *Aspergillus* were studied in greater detail: *A. fumigatus,* of which 16 strains were isolated from different soils, and *A. clavatus,* represented by 3 strains isolated from stable manure. In synthetic media, these two organisms produced active substances, that differed greatly in their chemical nature and in biological activity. These two substances were designated as *fumigacin* and *clavacin,* respectively.

Fumigacin is readily soluble in chloroform and in ethyl alcohol and to a limited extent in ether and in water; it precipitates from an alcoholic solution, on cooling, as fine, long, needle-shaped crystals. The substance is active against gram-positive bacteria but has only limited activity against gram-negative forms, as represented by *Salmonella* and the colon-aerogenes groups. Fumigacin is isolated from the medium by adsorption on norit, and subsequent elution with chloroform, after preliminary treatment of the norit with ether. The chloroform is removed by distillation and the active substance is dissolved in alcohol. Fumigacin is markedly different from the pigment fumigatin, isolated by Raistrick and associates,[4] in its mode of formation, chemical properties and biological activity.[5]

Clavacin is soluble in ether, chloroform, alcohol and water. As yet, it has not been isolated in crystalline form. It can be extracted from the culture medium by direct treatment of the culture filtrate with ether and chloroform, or it can first be adsorbed on norit and then removed from the latter by means of these solvents. It is readily soluble in dilute alkalies. Clavacin is particularly active against gram-negative bacteria, the colon-aerogenes group being nearly as sensitive as staphylococci and spore-forming bacteria. Another important characteristic of this substance is its high bactericidal property. It is known that most antibiotic substances act upon bacteria primarily as a result of their bacteriostatic properties; they are rather weakly bactericidal. Clavacin appears to be distinct from these in this respect, possessing both high bacteriostatic and high bactericidal properties, 6 to 18-hour-old cultures of various gram-negative and gram-positive bacteria being killed within 2 to 6 hours by dilution of 1:50,000 to 1:500,000 of the crude clavacin.

The substance recently isolated by Wiesner[6] from *A. clavatus* appears to be similar to clavacin, if not identical with it.

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[3] S. A. Waksman and E. S. Horning. In press.

[4] W. K. Anslow and H. Raistrick, *Biochem. Jour.,* 32: 687–696, 1938; A. E. Oxford and H. Raistrick, *Chem. Ind.,* 61: 128–129, 1942.

[5] S. A. Waksman, E. S. Horning and E. L. Spencer. In preparation.

## NATURAL PROTECTION AGAINST SUNBURN

EVERY one knows that skin which has been exposed to sunlight is less likely to sunburn than skin that has not been exposed. However, the explanation usually assigned is only partially correct at best. Skin which has been exposed ordinarily assumes a brown or tan color, principally due to the formation of melanin pigment,[1] and Finsen[2] about 1900 suggested that this pigment acts as an effective screen to mitigate the action of the sun's rays. This explanation seems so logical that it has been almost universally accepted. However, the pigment is located principally in the basal cell layer of the epidermis, whereas findings subsequent to Finsen's show that the cells primarily affected in sunburn are chiefly the prickle cells which lie superficial to most of the pigment. This arrangement of the pigment is characteristic of white skin, whereas in Negro skin it is more evenly distributed throughout the epidermis.

About 1927 Guillaume[3] suggested that the thickening of the corneum or horny layer of the epidermis might be the principal protective factor, *i.e.,* the thickening of this layer should decrease the amount of radiation penetrating to the cells beneath. This suggestion was followed up by Miescher,[4] who showed that sufficient thickening of the corneum occurs after exposure to sunlight to provide effective protection.

In the disease, *vitiligo,* certain areas of the skin do not produce pigment, but exposure of these areas to ultraviolet radiation causes a decrease in sensitivity to subsequent exposure.[5] This is further evidence that pigment is not the sole protective agent.[6]

[6] B. P. Wiesner, *Nature,* 149: 356–357, 1942.

[1] See E. A. Edwards and S. Q. Duntley, SCIENCE, 90: 235, 1939.

[2] N. R. Finsen, *Mitt. Finsens Med. Lysinstitut,* 1: 8, 1900.

[3] H. C. Guillaume, "Les Radiations Lumineuse en Physiologie et en Therapeutique," Paris, Masson et Cie, 1927.

[4] G. Miescher, *Strahlentherapie,* 35: 403, 1930.

[5] C. With, *British Jour. Dermatol. and Syph.,* 32: 145, 1920.

[6] For additional discussion and references see: F. Ellinger, "Radiation Therapy," New York, Elsevier Publishing Company, 1941; H. F. Blum, "Photodynamic Ac-

Demonstration that the transmission of the sunburn-producing wave-lengths by the epidermis of the albino mouse is greatly decreased by exposure of the animal to such radiation adds further evidence.[7]

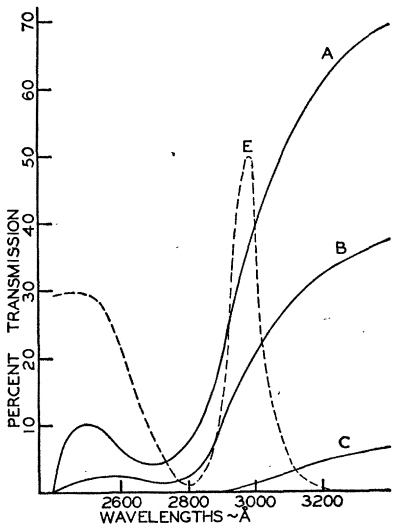


FIG. 1. A: Transmission of normal epidermis of albino mouse ear. B; Transmission of epidermis of ear of albino mouse exposed to ultraviolet radiation for 31 weeks. C; Transmission of well-pigmented epidermis of forearm of man. E; action spectrum of erythema of sunburn of man. This curve is not accurately established for the mouse but has approximately the same long wave-length limit.

These animals do not, of course, form melanin pigment, and hence the decreased transmission of the epidermis must result from some other change. The horny layer is thickened in the exposed animals, and this offers the most probable explanation for the decreased transmission. Fig. 1 illustrates this change in transmission in the region of wave-lengths that cause sunburn, together with curves of transmission by human epidermis.

None of this evidence completely rules out melanin as a factor in protection against sunburn. It shows, however, that it is not the only factor, and probably not the major one in the case of white skin. The melanin must function effectively in preventing penetration of the radiation below the epidermis, which may be of considerable importance in determining the site of cutaneous cancer.[7]

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tion and Diseases Caused by Light,'' New York, Reinhold Publishing Corporation, 1941.

[7] J. S. Kirby-Smith, H. F. Blum and H. G. Grady, *Jour. Nat. Cancer Inst.*, 2: 403, 1942.

## THE LISTING OF MEDICAL SCHOOLS

MAY I be permitted, as one long interested in collegiate statistics, to point out what I consider an unfortunate aspect of the article "Research Activity and the Quality of Teaching in Medical Schools," by Dr. Albert E. Casey, of the Louisiana State University, published in SCIENCE for July 31, 1942. I shall not discuss the validity of state board medical examinations as a criterion for the quality of medical teaching. I do wish to comment upon the publication in 1942 of a listing of medical schools based upon articles by faculty members appearing in medical journals from March, 1932, to March, 1934. The use of statistics which date back eight years or more to another decade is by no means justified by the back-handed statement that "Sufficient time has elapsed so that the standing of the schools need not necessarily be that of 1934."

The years since 1932–34 have been a period of notable personnel changes in medical faculties of the schools listed and consequent changes in research activity. For example, at the College of Medicine of the University of Cincinnati, our records show that the publications of research for the calendar years 1940 and 1941 are approximately twice those for the years 1932 and 1933. It is my impression that there have been similar advances at Duke, Vanderbilt, Louisville and other medical schools. To sum up, my fear is that Dr. Casey's listing of medical schools, based on old data, will be popularly quoted as representing their present status in respect to research activity and publication.

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## THE SHOT-PUT AND THE EARTH'S ROTATION

IN a most estimable weekly magazine having a circulation of millions is a department designed to enable its readers to keep up with the world. Once the editor of that department assured us that mercury poured into an open dish remained undiminished in weight, as though mercury gave off no vapor. Recently that department assured us that on account of the earth's rotation an athlete can put the 16-pound shot farther toward the east than toward the west. We are skeptical, for although it is quite true that the athlete while hurling the shot toward the east is moving toward the wished-for mark with a velocity of about 17 miles per minute, the mark at which he aims is moving away from him with that same velocity, with the net result that his shot-put is precisely the same as though the earth were standing still; similarly, if he puts the shot toward the west. Since a body moving south gradually grows lighter his put toward the south might per-