alcohol the first testis showed no further change in volume, while the second showed an increase to about 20 per cent. of its original size.

Phenol gives a peculiar elastic texture to the tissues, unlike anything produced by commonly used fixing fluids. Paranitrophenol comes nearest to phenol in this respect and, being stable in the mixture, is preferable where stability is desired. I have used both mixtures for arachnids, insects, myriapods, leeches, earthworms, flatworms, roundworms, older amphibian larvae and mammalian embryos. Professor J. S. Nicholas, of our department, is using my paranitrophenol mixture for rat embryos and fish in preference to sublimate or Bouin, while Professor W. R. Coe finds it very satisfactory for nemerteans. Macroscopic dissection of invertebrates and mammalian embryos fixed in either of these fluids is greatly facilitated.

No. 1. *Cupric-phenol fixing fluid.*

Stock Solution A.

Distilled water	100 cc
Nitric acid, c.p., sp.gr. 1.41–1.42	12 cc
Cupric nitrate, c.p., crystals $Cu(NO_3)_2 \cdot 3H_2O$	8 grams

Stock Solution B.

80 per cent. alcohol	100 cc
Phenol, crystals, c.p.	4 grams
Ether	6 cc

The stock solutions are perfectly stable and may be kept in glass-stoppered bottles. For use take: Solution A—1 part, Solution B—3 parts. The mixture does not keep and must be used within a few hours. For the same reason the duration of fixation must not exceed 48 hours. 12 to 24 hours will suffice in most cases. Wash in several changes of 70 per cent. alcohol.

The following fluids are perfectly stable and may be kept for months in glass-stoppered bottles:

No. 2. *Cupric-paranitrophenol fixing fluid.*

60 per cent. alcohol	100 cc
Nitric acid (as above)	3 cc
Ether	5 cc
Cupric nitrate (as above)	2 grams
Paranitrophenol, c.p., crystals	5 grams

Duration of fixation not limited by time, except as to the minimum time required for penetration at the rate of one half millimeter per hour. Wash in several changes of 70 per cent. alcohol.

No. 3 to No. 6: These fixing fluids have the same composition as No. 2, except that in place of 5 grams of paranithrophenol they contain 0.5 gram of one of the following nitroderivatives of phenol: No. 3—orthonitrophenol, No. 4—alpha (2:4) dinitrophenol, No. 5—beta (2:6) dinitrophenol, No. 6—picric acid (2:4:6 trinitrophenol). Fixation and washing as in No. 2, but Nos. 5 and 6 require longer washing and leave the tissues yellow.

ALEXANDER PETRUNKEVITCH
YALE UNIVERSITY

SPECIAL ARTICLES

VARIATIONS IN VISIBLE SOLAR LIGHT DURING SUBMARINE MEASUREMENTS

WHILE making measurements on the intensity of some of the components of visible solar light beneath the surface of ocean waters, variations in the intensity of the incident light were found to be of such magnitude, on some days, that considerable uncertainties are introduced into the results if these variations are unaccounted for. These variations are not ones which depend upon zenith distance, but are occasioned by other circumstances. They are of particular importance when the depth of water is such that very small currents result in the submerged photoelectric cell. These variations occur on days when the sky is cloudless and the atmosphere very clear to the eye.

The time required to make a series of measurements of illumination intensity beneath the sea with a photoelectric cell to a depth of 50 meters, say, is an hour or more if one-meter intervals are chosen as unit layers of the absorbing medium. During this time the illumination intensity of the radiation incident upon the surface of the water changes slowly with the variation in the solar zenith distance. Also, the intensity of the visible light may vary within a few minutes by several per cent., even though there be a cloudless sky and a clear atmosphere. A study of these variations made during the summer of 1932 at the Friday Harbor (Washington) station of the Oceanographic Laboratories also show that a record of the total radiation intensity on a horizontal surface is not indicative of all changes which may occur in the illumination intensity.

Such variations are shown in Fig. 1. The total radiation was measured by means of an Eppley pyrheliometer connected to an Engelhard recorder. This instrument had recently been calibrated by Dr. Herbert H. Kimball in charge of solar radiation for the U. S. Department of Agriculture. The illumination intensity was measured by means of a calibrated photoelectric cell.

The curves in Fig. 1 are characteristic of the obser-

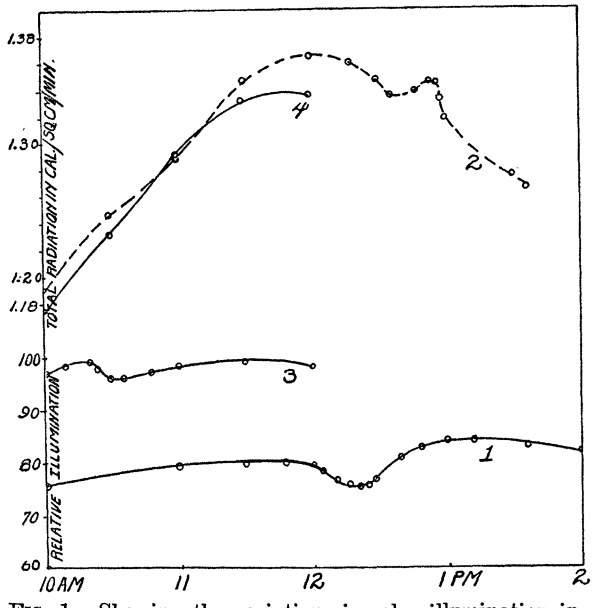

FIG. 1. Showing the variations in solar illumination intensity and total radiation.

vations. In making the observations the pyrheliometer and the cell were located near each other. Days were selected when there was no evidence of clouds or haze. The air in the region of the laboratories was entirely free from smoke. The days on which observations were made can well be called clear and cloudless.

Curves 1 and 2 were plotted from observations made on July 26, while curves 3 and 4 show the variations several days later. Curves 1 and 3 show the variations in the solar illumination intensity. Curves 2 and 4 show, respectively, the simultaneous variations in the total radiation. These data were selected from a series of observations to exhibit the magnitude and rapidity of the changes in illumination.

It is at once apparent from the illumination curves that on these days rather rapid changes are superimposed upon the changes due to zenith distance. Also, changes in illumination are not indicated by changes in the total radiation, although in curve 2 of July 26 a rather small but sudden change occurs in the total radiation at 11 A. M., and another more marked change between 12:40 and 1 P. M. Curve 4 shows only the gradual change in total energy, while simultaneous readings of illumination show a sudden change at about 10:20 A. M.

That a relation exists between radiation intensity and illumination has been shown by Kimball.[1] This relation is that radiation in calories per minute per cm² on a horizontal surface multiplied by 6,700 will give the illumination in foot-candles on a horizontal surface within ±5 per cent., the variation being characteristic of the position of the sun. This relation agrees, in general, with the present results, but does not account for the rapid changes found.

In a study of the penetration of light into water, Shelford and Gail[2] did not take into account any variations in the incident light, although they apparently suspected variations to exist. In a later study, Shelford[3] *assumes* that, under a cloudless sky and a very clear atmosphere, the intensity of the visible solar light incident on the surface of water is constant between the hours of 10 A. M. and 2:30 P. M. Variations due to solar zenith distance and the smaller variations illustrated in curves 1 and 3 show that such constancy does not exist.

Poole and Atkins,[4] during a series of determinations of the penetration of the *total* visible light into the sea near Plymouth, found variations in the incident light with a bright sun, although they do not state that the sky was cloudless and the atmosphere clear.

It is evident that in making measurements of the absorption of visible light by ocean waters a knowledge of the variations in the incident light is quite necessary. The results of a study of the penetration of some of the components of visible solar light into the waters of Puget Sound and of Southern Alaska will be published soon.

C. L. UTTERBACK

OCEANOGRAPHIC LABORATORIES
UNIVERSITY OF WASHINGTON

BORRELIOTOSES: FOWL-POX, MOLLUSCUM CONTAGIOSUM, VARIOLA-VACCINIA

THE judgment first expressed by Borrel,[1] that the specific granules of fowl-pox may well be the actual virus of this disease, a view later held by Lipschütz and by Paschen with respect to the specific granules of molluscum contagiosum and vaccinia, has received from recent studies strong support. Evidence has likewise accumulated which effectively upholds the view that the specific cellular inclusions (Bollinger bodies, molluscum bodies, Guarnieri bodies) of these three infections are composed essentially of colonies of the respective viruses which appear to be microorganisms and seem to require an intracellular environment in their hosts for their reproduction.[2,3,4,5]

[1] H. H. Kimball, *Mo. Weather Rev.*, 52: 473, 1924.

[2] V. E. Shelford and F. W. Gail, *Pub. Puget Sound Biol. Sta.*, 3: 141, 1922.

[3] V. E. Shelford, *Pub. Puget Sound Biol. Sta.*, 7: 151, 1929.

[4] H. H. Poole and W. R. G. Atkins, *Jour. Marine Biol. Assoc.*, 14: 170, 1926; *ibid.*, 15: 455, 1928.

[1] A. Borrel, "Sur les inclusions de l'epithelioma contagieux des oiseaux," *Compt. Rend. Soc. Biol.* 57: 642, 1904.

[2] C. E. Woodruff and E. W. Goodpasture, "The Infectivity of Isolated Inclusion Bodies of Fowl-Pox," *Amer. Jour. Path.*, 5: 1, 1929.

[3] E. W. Goodpasture and C. E. Woodruff, "A Com-