(1) between quadrilateral and hexagonal
(2) between hexagonal and hexagonal
(3) between hexagonal and quadrilateral
(4) between quadrilateral and hexagonal
(5) between hexagonal and hexagonal
(6) between hexagonal and quadrilateral faces.

It will be seen further that there are two angles of type A (between hexagonal and hexagonal faces) and four angles of type B (between hexagonal and quadrilateral faces) and these angles of the polygon (a hexagon) sum up to 720 degrees. It follows then that:

$$A + 2B = 360 \text{ degrees.}$$

It must be evident that the volume is stackable if the dihedral angles around any and every line at the intersection of planes can be shown to be three in number, one of which is of type A and two of which are of type B. Perhaps at this stage it would be well to heed Millis's advice and construct a model. This can be rather easily done by paper-folding, or by taking a fairly stiff copper wire and a pair of pliers and weaving the desired pattern. It is then quite easily shown that, when stacked, any line of intersection in the mass is at once the side of an equilateral quadrilateral and of two adjacent equilateral hexagons. The dihedral angles are therefore: one of type A (hexagon-hexagon) and two of type B (hexagon-quadrilateral).

It should be pointed out that the octahedron should truncate the cube in such a way that equilateral hexagons result, *i.e.*, all sides of quadrilaterals and hexagons are equal. If this is not done, the 1, 3, 5 sides of a hexagon will not be the same length as the 2, 4, 6 sides. Experimentation will show that in stacking the volumes the 1, 3, 5 sides of a hexagon in one figure must coincide with the 2, 4, 6 sides of a hexagon in a second figure, etc. Obviously, if they are of unequal length, this becomes an impossibility and therein may lie a meager basis for Millis's error.

There is no doubt that the figure mentioned by Lewis is stackable.[2]

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[2] When the letter from Colonel Millis was brought to the attention of Professor W. C. Graustein, he wrote out a brief mathematical demonstration that Lord Kelvin was right; tetrakaidecahedrons are space-filling. Meanwhile Colonel Millis, quite independently, had arrived at the same conclusions. The publication of their letters was not requested. A further treatment of the same subject may be found in the *Bulletin of the Torrey Botanical Club,* 1927, Vol. 54, pp. 341–348.—EDITOR.

EARTHWORMS AND LIGHT

IN a previous note printed in SCIENCE I have mentioned the effect that ordinary light, such as that emitted by a three-celled electric flashlight, has on earthworms. When such a light is thrown at close range on the anterior or pigmented portion of the worm's body it usually causes instant withdrawal of the creature into its burrow. It seems quite possible that sensitivity to light in the earthworms is associated with this pigment, which is of a purplish hue and in sunlight glistens with iridescent color. It occurs most densely on the anterior fourth of the body, which region quite obviously is most sensitive to light.

Recently I have experimented with lights of various colors to determine the reaction of the worms (*Lumbricus terrestris* Linn.), to them and was much interested to discover that light transmitted through a red glass of the sort commonly used for photographic dark-room lamps had no visible effect on them, as apparently they did not perceive it. A 40-watt electric light bulb was used in the red lamp and even when this was brought within four inches of the worms they continued undisturbed in their ordinary occupations of feeding and dragging various objects into their burrows. Quite a different reaction was caused by rays from the opposite end of the spectrum, as when a blue light of a dark shade was flashed upon them they withdrew rapidly to the earth. By use of a suitable red light it is possible to observe accurately the behavior of such worms, and I am publishing this information for the benefit of those investigators who are interested in the problem of the origin of the sounds recently discovered to be emitted by earthworms.

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RESPIRATION OF INSECTS

IN SCIENCE for May 6, 1927, appeared a note under the above title by D. A. MacKay. The general conclusions drawn in this note would not seem to be warranted by the data presented, especially in view of the fact that contrary results have been reported previously.[1] In reference to the idea that in the grasshopper air is alternately inhaled and exhaled through all of the spiracles, the statement is made that "the same thing is probably true of all insects." As a matter of fact in a number of species of insects (the blowfly, Dytiscus and Cybister beetles), in which the mechanics of respiration have been studied, certain spiracles have been shown to be inspiratory and others expiratory.

[1] Lee, M. O., *Jour. Exp. Zool.,* 1925, XLI, 125.

The one experiment described by MacKay which would indicate that the thoracic spiracles serve equally well for inhalation and exhalation, does not seem to be conclusive. In this the head and thorax of a grasshopper were placed under water and the abdomen left out. The bubbles of air which came from around the thorax may have escaped through the injured valve of a spiracle or may have been carried under the water adhering to the waxy chitin. I have made such tests repeatedly on grasshoppers, cockroaches, walking sticks and representatives of every other family of Orthoptera, and have never seen air pumped out of the thoracic spiracles of normal animals. Sometimes when the head and thorax of the insect are thrust under water some air is held around the head and legs. This air may collect as bubbles and float to the surface, and might seem to have come from the spiracles. Also, if the spiracular valves are held or torn open, air bubbles may escape at each contraction of the abdomen. In such an experiment with the head and thorax submerged, the abdominal spiracles which normally open during the collapse and close during the expansion of the abdomen, remain open continuously, evidently serving both for inspiration and expiration. It is true that in such a case the respiratory movements go on and complete asphyxia does not occur. There is, however, some evidence of partial anoxemia in the lessened irritability of the animal.

A few other data bearing on the question might be reviewed briefly. The movements of the valves of the spiracles indicate clearly their actions in inspiration and expiration. The valves of the anterior four pairs of spiracles very plainly open during the inspiratory phase of the cycle (enlargement of the abdominal cavity) and close during the expiratory phase (collapse of the abdomen). The thin, membranous portions of the neck and thorax may be seen to bulge out during each expiration, and this does not occur if the valves of any thoracic spiracles be held open. Further, if the valves of the thoracic spiracles are held open while under water, air bubbles escape at each contraction of the abdomen.

That the abdominal spiracles do not function normally as inspiratory orifices is indicated by the fact that with the abdomen submerged in water, bubbles of air appear over the spiracles and become noticeably larger at each contraction of the abdomen.

The size of the bubble is not noticeably decreased during the expansion of the abdomen, as must surely occur if the abdominal spiracles acted as inspiratory orifices.

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FUNDAMENTALISM IN PHARMACY

PROFESSOR GRIER'S letter in a recent issue of SCIENCE has acquainted the scientific public with the change that has occurred in the management of Des Moines University. The issue of *The Gospel Witness* (a publication in the interest of the American Baptist Bible Union) for July 21 contains an account of the investigation of the faculty of the department of pharmacy at the university as follows:

> Two excellent gentlemen were in charge of the college, but the head was a Unitarian. After meeting him we were not surprised to learn that he was very popular with the students. He is a delightful man, whom we all coveted for the Lord Jesus Christ, but, under the circumstances, it became necessary for the faculty to find a new head for the institution.

HENRY LEFFMANN

QUOTATIONS

EPIDEMIC ENCEPHALITIS IN ENGLAND

THE Minister of Health stated the other day, in a written answer to a question, that during the past five years nearly 5,000 persons have died in England and Wales of epidemic encephalitis, the so-called sleepy sickness. During the same period 11,420 cases of the disease have been notified, so that the melancholy fact emerges that nearly half of all those stricken by epidemic encephalitis in this country have succumbed. The fate of those who have escaped death was not referred to by Mr. Neville Chamberlain, but a long series of researches, extending over the known "history" of the disease, suggests that recovery, in the true meaning of that word, is the exception rather than the rule. Epidemic encephalitis leaves behind it, in the majority of instances, damage to body or to brain of a more or less severe kind. As is well known, it possesses the power of transforming character, and this transformation is nearly always from good to bad. It possesses also the power of inducing that form of paralysis known as "Parkinsonism." So grave a malady merits, without doubt, the close attention of the public, especially since it seems to have become established in this country. The Minister of Health pointed out that there were 2,267 fresh notifications of epidemic encephalitis in 1926, 2,635 fresh notifications in 1925, 5,039 fresh notifications in 1924, 1,025 fresh notifications in 1923, and 454 fresh notifications in 1922. The epidemic wave, which reached its highest point in 1924, has therefore by no means subsided, though it has been reduced in magnitude.

It is a temptation in these circumstances to urge that research work on the unknown origins and