Henry R. Viets, 8 The Fenway, Boston, Mass., is secretary of the society.

THE regular summer meeting of the Pennsylvania Academy of Science will be held at Laporte, Pa., on August 11 and 12. Field trips in botany and geology are planned. For further information, address the Secretary, Dr. V. Earl Light, Lebanon Valley College, Annville, Pa.

THE American Institute of Physics, New York City, has announced that it will conduct from November 2 to 4 a symposium on temperature. It is planned to coordinate the treatment of the subject of temperature in the several branches of science and engineering, to review principles and record recent work, to accumulate contributions for a comprehensive text to be published after the symposium, to emphasize the importance of temperature as a branch of physics and to improve technical curricula through making available up-to-date information.

DISCUSSION

SURFACE CURRENTS IN DEEP TIDAL WATERS

IN a recent article in SCIENCE, Shepard, Revelle and Dietz[1] report the discovery of unexpectedly strong bottom currents well out on the rugged continental shelf off the coast of Southern California. They note that these currents can not be explained as tidal currents of the regularly alternating type usually recognized, but must be due primarily to large eddies having no direct relation to the state of the tide.

Since some observations of my own during several summer vacations have led me to a similar conclusion about many surface currents in the deep water of the Inside Passage along the coast of British Columbia and since the importance of such eddies is only beginning to be recognized, I venture to present the results of these observations, even though they are only those of an amateur.

So far as I have observed, the times and heights of high and low water in the Inside Passage and its tributaries follow the predictions in the tide tables remarkably well, indeed so accurately that I have sometimes set my watch by them and later found it right within five minutes. The same is true of the times of turning of the current in the tidal rapids, of which there are at least ten on this coast strong enough to make white water. On the other hand, there are passages such as Welcome Pass, about 40 miles NW of Vancouver, where I have observed the current many times, and where there is no way to predict it at all. Thus on consecutive days with but little difference in the heights of the highs and lows, one may observe the current at corresponding tidal intervals and find it running in opposite directions on the two days, often with a strength of one or two knots, which is about as strong as the current gets in this pass. This pass differs from ones where the current can be predicted, however, in running parallel to a much wider alternative passage between the two bodies of water which it connects and in having only a moderately strong current.

[1] F. P. Shepard, R. Revelle and R. S. Dietz, SCIENCE, 89: 488, May 26, 1939.

Similarly along the shores of the Strait of Georgia, in the calm, clear weather that justifies the local steamship company in calling it "The Sunshine Belt," one may often observe currents of a knot or so, either alongshore or toward the shore or boiling up out of the bottom near the shore or meeting one another and sinking along a line made visible from afar by a thick accumulation of driftwood. Such currents all show a similar unpredictability.

My guess on the origin of these currents has been that they are eddies broken off from the strong tidal currents entering the Strait of Georgia through the relatively narrow Rosario and Haro Straits and Discovery Passage. With the configuration of the shore and bottom as it is, any such eddy, formed in the flood, can easily become detached from the current of the narrow strait and wander about aimlessly all over the Strait of Georgia. The observation of these unpredictable currents at places 60 or 80 miles away indicates that the eddies may persist for many days after detachment.

A similar effect occurs in the narrow fjords, such, for example, as Jervis Inlet. In this inlet the chart reports tidal currents of one knot, both ebb and flood, in places where calculations from the cross-sections of the fjord and the areas inland of those places would not indicate as much as one tenth of a knot, and where there are no big currents of fresh water like that of the St. Lawrence River. In some of those places at least, the currents are unpredictable. This I have observed especially in Jervis Inlet; and likewise in Alaska, in Le Conte Inlet. In the latter fjord I have observed the eddies only once, but that time with considerable detail owing to the fact that the eddies unexpectedly packed the small icebergs from Le Conte Glacier in around me and almost crushed my boat. On that occasion, with the boat unable to make her usual speed, the slow milling around of the icebergs gave a clear picture of the big, slow eddies.

My general conclusion from these observations, then, is that in deep waters of this type, aside from narrows or straits carrying exceptionally strong currents, the current at any point is most likely to be primarily due to eddies having their origin in stronger and more strictly tidal currents at other places.

In this respect the deep waters of British Columbia and Alaska show a marked contrast to such shoal waters as Nantucket Sound, Massachusetts, where the currents are almost entirely strictly tidal. As a physicist I feel sure that the difference is due primarily to the great influence of viscosity in the shoal waters and the lack of it in the deep. In the same capacity, I would guess that there would be still less influence of viscosity in such larger and deeper waters as Shepard, Revelle and Dietz have been studying. Therefore we may expect their conclusions to apply very generally in deep waters with rugged bottoms.

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PROBLEMS OF WOUND HEALING IN RED CLOVER STEMS

FORAGE legumes, like other herbaceous plants having no protective covering other than an epidermis, are subjected to injury by grazing animals and insects. In particular, the mowing of fields is a severe test both because of the wounds and also through the loss of the plant body including most of the buds. In spite of such injuries these plants are usually able to continue growth though frequently with some modification of form and size.

The stems of three important herbaceous legumes—*Trifolium repens* L., white clover, *Medicago sativa* L., alfalfa, and *Trifolium pratense* L., red clover—were studied with respect to the time and the nature of their wound responses. While primary interest centered in the healing processes, attention was given to various conditions, interrelated with lesion, which may cause the death of these legumes.

In connection with the healing of wounded herbaceous stems considerable credit must be given to the preliminary barrier or pseudocicatrice,[1] formed by death and collapse of tissue following injury. This, in itself, is protective in considerable degree and by checking the dying back of tissues permits certain underlying cells to develop a permanent barrier of wound cork, the cicatrice, which effectively heals the wound. Ultimately, in the three legumes studied, a region of solid living pith at some point in the injured stem permits the protective structures to be formed.

The pith in white clover generally remains alive and completely fills the central zone. Following a transverse cut a continuous pseudocicatrice quickly covers the injured surface. Suberin is demonstrable in the walls of the outermost living cells underneath the pseudocicatrice within thirty-six to forty-eight hours after lesion. By the sixth day suberization has extended from two to four cells further into the underlying tissues. About this time mitoses begin in subjacent cells, and this phellogen forms two to five additional layers of cork, which completes the cicatrice. Its development requires about fifteen days, and in final form it extends entirely across the stem, interrupted only by the vascular tissue.

However, in certain stems of white clover the central region of the pith dies and spaces develop. Following a cut across one of these hollow stems the pseudocicatrice can not be completed across the pith region, and water loss by way of this cavity causes the stem to die back to the nearest node. There a block of living parenchyma furnishes a foundation upon which a continuous pseudocicatrice is built. Four to five days may be required for the stem tissues to die back to this node, and both initiation and completion of the barriers are correspondingly delayed. Ultimately a cicatrice is always developed in the firm tissue of the node, similar to that which is built at the plane of injury in stems having solid living pith.

The pith of alfalfa stems is dead and broken throughout all internodes, but at the nodes there is usually a continuous living tissue. Consequently its healing processes correspond closely with those of white clover stems having dead pith. Dying back to the node takes five to ten days, but in the nodal zone the cicatrice is quickly formed. In general, mature alfalfa stems are safely healed within twenty-one days.

In red clover the pith is larger and makes up over half of the stem's diameter, relatively more than in white clover or alfalfa. Because this pith normally dies within two cm of the meristem, growth of the internodes breaks down the central tissue, leaving hollow stems. The nearest lower zone of solid living cells is at the junction with the crown, unless there is a growing lateral branch with sufficient living pith at the junction to permit the formation of protective barriers. The defective pith causes the whole axis to die downward to where a platform of living cells makes possible the establishment of the pseudocicatrice, which is quickly followed by the cicatrice of wound cork.

Due to this prolonged dying back of all wounded red clover stems there is necessarily a considerable delay in healing processes. When cut as low as four inches from the base there is a lapse of two to three weeks, even in midsummer, between the time of injury and the earliest evidence of healing. This means an interval of at least a month between the date of injury and completion of the cicatrice. This dying back of stems slows down later in the growing season and during the autumn months the development of healing tissues is greatly retarded or entirely inhibited. Rarely does a cicatrice reach completion before winter if a stem is cut across after early September. Successful healing takes place in the autumn only when

[1] Robert B. Wylie, *Bot. Gaz.*, 90: 260–278, 1930.