Lancaster County" (Penn.) and now we must add two more similar books to his credit. They are the "Flora of the Florida Keys" and the "Shrubs of Florida" both of which appeared within the last few months. The first is a neat little volume of about 160 pages containing descriptions of the seed plants growing naturally on the islands of the Florida reef from Virginia Key to Dry Tortugas, a distance of about 225 miles. As the author remarks, "we find here a tropical flora made up almost wholly of West Indian elements, and closely related to the floras of Bermuda, the Bahamas and Cuba." To a northern botanist it seems strange to find among the grasses no species of *Poa,* nor of *Bromus;* in the sedges no species of *Carex;* in *Brassicaceae* but four species; in *Rosaceae* no species; while the leguminous families aggregate 57 species; *Euphorbiaceae,* 45 species; *Malvaceae,* 17 species, and *Rubiaceae,* 22 species. Of the three families of composites there are but 44 species.

In the other little book (of 140 pp.) the northern botanist will be astonished to find a shrubby grass [*Lasiacis* (*Panicum*) *divaricata*], a buckwheat (*Coccolobis*) forming "evergreen shrubs or trees," the Castor-oil plant (*Ricinus communis*) "a small tree or shrub," a shrubby heliotrope (*Heliotropium*), and a low shrubby *Eupatorium.* Both books will well repay careful examination.

SHORT NOTES

AN interesting paper by Dr. W. B. McDougal on "The Mycorhizas of Forest Trees" appeared in the first number of the new *American Journal of Forestry* showing that in some cases the relations between the tree and the fungus is symbiotic and sometimes parasitic.

FREDA M. BACHMANN's paper on "The Origin and Development of the Apothecium in *Collema pulposum*"[1] is a valuable contribution to the theory as to the phylogeny of the Ascomycetes propounded by Dr. E. A. Bessey,[2] in which he suggested that the first Ascomycetes were lichens. In her paper Miss Bachmann says "in the number and nature of its spermatia and in the manner in which they are borne, *Collema pulposum* forms about the most perfect conceivable connecting link between the aquatic red algae with many non-motile male cells which are, however, set free, and such terrestrial ascomycetes as *Pyronema* and the mildews where the male cells are reduced in number to one or two which remain permanently attached."

A RECENT handful of papers from Professor Doctor Aven Nelson reminds one of the taxonomic activity of the director of the Rocky Mountain Herbarium at Laramie, Wyoming, and serves to show that there is still much to be done in the systematic botany of the central mountains of the country.

DR. O. E. JENNINGS's "Manual of the Mosses of Western Pennsylvania" (1913) should have been noticed long ago, since it offers to botanists in the central east a descriptive manual of these plants accompanied by fifty-four full-page plates of original drawings. The book includes somewhat more than four hundred pages, and is a credit to the author, and the institution (Carnegie Museum, Pittsburgh) from which it is issued. All told more than 275 species and varieties are described. The treatment is modern, the specific names being decapitalized, and "the rulings of the International Botanical Congress, held in Brussels in 1910, have been followed."

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[1] *Archiv. für Zellforschung,* Band X., Heft 4.
[2] *Mycol. Centralbl.,* Vol. III.

SPECIAL ARTICLES

CELL PERMEABILITY FOR ACIDS

SINCE Overton's first extensive and well-known studies and his publication of the lipoid theory, interest in the subject of cell permeability has continually increased. Although adherents of the theory have modified and supported it with subsidiary hypotheses the two essentials remain unchanged to-day, namely—(1) that substances which are most soluble in lipoids (fat solvents or fat-like bodies) enter living cells most readily and (2) that they do so because they dissolve in the cell surface which is lipoid in nature.

Opinion concerning the lipoid theory is divided among those who deny the truth of both first and second statements; those who admit the first but not the second and those who accept the theory in its entirety.

The acids form a group of substances of particular interest in this connection in that they are bodies widely different in chemical composition and physical properties—lipoid solubility, degree of dissociation, surface tension—yet the entrance of each into a living cell may be detected by the same method—color change of a suitable indicator within.

It is impossible to stain living cells with dyes which will serve as indicators for acid, as I had previously done for alkalies,[1] so that recourse must be had to organisms with natural indicators. In plants the blue anthocyan pigments of petals are not sensitive enough to weak acids, such as acetic, to warrant their use. In animals despite the number and the variety in color of pigmented forms, indicators are very rare.

Last winter while a member of the Great Barrier Reef Expedition of the Carnegie Institution at Washington, I discovered a Holothurian, *Stichopus ananas,* the "prickly fish" of the Beche de Mer industry, whose viscera contain a purple water-soluble pigment turning red-orange in a concentration of acid between $n/1{,}000 - n/500$. The chemical composition of the pigment is unknown, but it appears related to the antedonin described by Moseley[2] from crinoids and a deep-sea Holothurian. The purple color is contained in sacs or bodies of unknown nature thickly scattered just under the epithelium covering the various viscera, and is especially abundant in the testes and ovaries, although not in the sperm and egg cells themselves. It is of importance to note that the pigment is contained in or surrounded by living cells and death of the tissue results in a rapid diffusion of the purple from the cells as in the case of so many other pigments. Acid diffusing toward the indicator must therefore pass through the layer of living epithelial cells.

A study of the penetration times of a large

Penetration Rate Tissues of "Prickly Fish" from $n/100$ Concentration		Toxicity to Cilia of Giant Clam[3]		Strength of Acid Percentage Dissociation at $n/128$ Conc.		Lipoid Solubility Equivalent Partition Coefficient Xylol/Water		Capillary Activity Surface Tension of n and $n/4$ Conc. where Water = 7.3 Mg.-Mm.		
¼ min.	Benzoic,	$n/2500$	Salic.	.96–.99	Nit.*	2.5	Benz.	n	$n/4$	
	Salicylic,		Benz.		Hydroc.*	1.3	Salic.	?	?	Benz.
2–4 min.	Valeric (iso-),	$n/1666$	Monoc.		Tric.	0.6	Val.	?	?	Salic.
	Monochloracetic,		Dic.	.88	Sulph.*	0.1	Buty.*		3.56	Val.
	Dichloracetic,	$n/1111$	For.		Dic.	0.02	Prop.*	3.30	4.39	Buty.*
	Trichloracetic,	$n/1000$	Tric.	?	Oxal.*	0.015	Monoc.[4]	4.82		Tric.
	Formic,		Sulph.*	?	Phos.*		Dic.[4]	4.82	6.13	Prop.*
9–11	Nitric,		Tart.*	.67	Maleic*		Tric.[4]	5.20		Dic.
	Hydrochloric,	$n/909$	Val.*	.58	Malon.*	0.005	Maleic*[4]	6.00		Monoc.
	Sulphuric,	$n/833$	Nit.	.35	Monoc.			6.04	6.81	Acet.*
	d-Lactic,		Hydroc.	.30	Fum.				7.07	Malon.*
	l-Lactic,		d-Lac.		Tar.				7.11	Maleic*
12–15	Fumaric,		l-Lac.		Salic.*			6.83	7.14	For.
	Oxalic,		Fum.		Cit.				7.17	Malic*
	Glycolic,		Glyc.	.20	Malic				7.24	Glyc.
20	Maleic,		Maleic	.13	Form.*			7.19	7.27	Nit.
30	Malonic,		Malon.		Glycol.			7.25	7.28	Hydroc.
	Tartaric,		Malic		d-Lac.			7.27	7.30	Sulph.
	Phosphoric,		Cit.		l-Lac.				7.27	Oxal.
40	Malic,	$n/769$	Acet.	.08	Buty.*			7.27	7.29	Tart.
	Citric,		Prop.	.04	Val.*				7.27	Cit.
45–60	Acetic,		Buty.		Acet.					
	Propionic,	$n/400$	Phos.*		Prop.					
	Butyric,				Buty.					

[1] *Jour. Exp. Zool.,* Vol. 10, 1910.

[2] *Quart. Jour. Microscop. Science,* Vol. 17, 1877.

[3] Conc. which just kills in 20 hours.

[4] Insol. in xylol from $n/100$ conc. in water but slightly sol. from $n/10$ conc. Remaining acids insol. from $n/10$ conc. in water.

series of acids, organic and inorganic, was made and the results are given in the table on p. 948. Pieces of the testis, a branched filamentous organ, were placed in a $n/100$ concentration of acid and the time for color change noted. In addition the partition coefficients of the acids between xylol/water was determined as a measure of the lipoid solubility. Only a very few acids will pass to xylol from $n/100$ concentration in water and a few more from $n/10$ concentration. The strength of the acid (after Ostwald), its effect in lowering the surface tension of water (after J. Traube) and its toxicity for cilia (studies of my own carried out in Torres Strait) are also included in the table. The acids are arranged in order of efficiency in each case. Those with nearly the same effect or property are tabulated in groups and in an order to correspond as nearly as possible with the penetration series. An asterisk marks the acids considerably out of place in each series as compared with the penetration series.

With the exception of benzoic and salicylic all the acids encounter a resistance—small for some, greater for others—at the cell surface. If the tissue has previously been killed this resistance is abolished and the cells become readily permeable for all acids. The specific permeability of the tissue for each acid is therefore dependent on the living cells.

It will be noted that there is no exact quantitative agreement between any two of the series. The best agreement is between penetration rate and toxicity; the worst between penetration rate and degree of dissociation. One may conclude that those acids are most toxic which are able to penetrate the cell most rapidly, a conclusion supported by my results with alkalies. In neither case is there a relation between toxicity and dissociation.

As regards the lipoid theory my results can not be said to wholly support it; neither do they wholly contradict it. The same statement applies to Traube's Haftdruck theory. There is a general relation between the power to lower the surface tension of water (capillary activity) and rate of penetration, but it is not exact. With acids as with dyes and so many other substances, Overton's theory applies in the majority of cases, but not in all. In my opinion this can only mean that the power of penetration of an acid depends on several variable factors. One of these is lipoid solubility or capillary activity, for the two run more or less parallel, and a second is the strength or affinity of the acid for certain protein substances of the cell surface. This would explain the rather rapid penetration of strong acids little soluble or insoluble in lipoids.

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PRINCETON, N. J.,
April 28, 1914

A DESTRUCTIVE STRAWBERRY DISEASE

MANY of the long-distance strawberry shipments of this season have suffered serious injury culminating in a condition designated by the consignees as "molds" or "leaks."

In case of mold the berries, one or more per box, often quite the whole contents of the box, are more or less densely covered with a hairy mold.

The term "leak" designates a condition in which a liquid issues copiously from the bottom of the box. "Leaks" are accompanied by a soggy condition of the berries which mat down to occupy only one third or one fifth of their original volume.

The loss occasioned by these conditions is very large and will in all probability reach well into the millions this season. The berries now so affected originate in Louisiana and Mississippi. Data are not available concerning conditions in other states. The conditions mentioned have not occurred in previous years to sufficient extent to attract the marked attention of the buyers or inspectors though it is hardly to be supposed that they have been entirely absent.

The writer on April 30, acting for the Illinois Central Railroad, visited the berry region of Louisiana to ascertain the condition, the cause, and to render any assistance possible.

A preliminary examination at Hammond, La., May 1, of berries which had been in refrigerators over night, which had been picked