along those lines of the chemistry of sanitation in which she was interested, and the other to be used in the interests of Home Economics, are already of considerable size, and, if still further supported, will do much to perpetuate her life work.

If the zeal of the biographer has occasionally (though seldom) led to the use of ultra-superlatives, it is far more frequently true that, in the compass of such a work as this, it has been impossible to do full justice to her attainments in so many fields. The volume is amply illustrated (the frontispiece being a most excellent photograph of Mrs. Richards, taken near the close of her life) and it can hardly fail to be a source of gratification to all concerned with its preparation. It is a book which should be widely read and from which much pleasure and profit is sure to be derived.

H. P. Talbot

The Examination of Prospects. A Mining Geology. By C. Godfrey Gunther. New York, McGraw-Hill Book Company.

This book, which is attractively bound in flexible leather as a pocket manual of 221 pages, presents the practical side of the geology of metalliferous ores, excepting iron and placers. Sound advice is given on the procedure of the examination and sampling of mines, and especial attention is devoted to the outcrops and structural features of ore deposits.

The writer states at the outset that a great proportion of the deposits having outcrops of commercial grade or of evident promise have already been recognized and explored. Rich discoveries at the surface belong to pioneer days, and as time goes on the more important developments are the result of lower working costs, improved metallurgical processes, and of an increasing knowledge of economic geology. As engineers in search of developed mines no longer expect to find properties having positive ore of greater net value than the price asked, so those in search of prospects should not expect to find proved ore-shoots awaiting their recommendation. There is usually local capital for the preliminary development of a patently good prospect, and most of these are steadily worked from the time of their discovery until some apparently unfavorable development shuts off the supply of local capital. These statements recall one frequently heard that "all mines are poor at the bottom." The basis is partly geological and partly psychological, for men seldom stop digging when in bonanza. A great majority of prospects have been examined again and again, presumably by men who commanded a knowledge of sampling, the services of an assayer, and at least an elementary knowledge of geology. In order to pick a good prospect from those rejected by his predecessors, therefore, an engineer must base his hope of success upon superior geological training.

Although the author does not attempt a genetic classification of ores, he does present in a logical and effective manner a mass of carefully chosen and ably digested material.

The treatment of the superficial alteration of ore deposits and the secondary enrichment of copper, silver and gold ores is concise and clear; but in view of Stokes's experiments in the solution of gold in ferric salts, the statement that gold is dissolved in solutions of ferric hydrate would seem to demand experimental proof. Numerous examples are cited of changes in value and character that have been noted as ore lodes are followed in depth. The many text figures, which are well chosen and well executed, add greatly to the attractiveness and value of the volume, and both the author and publisher are to be congratulated on its appearance.

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SPECIAL ARTICLES

NOTE ON THE DEVELOPMENT OF AMPHIBIAN LARVÆ IN SEA-WATER

That the amphibia are poisoned by common salt, and hence geographically restricted to regions free from this substance, is a general belief, apparently so well supported by observa-

tion and experiment, that the contradictory evidence brought forward recently by Pearse[1] seems at first sight enigmatical. However his discovery of frog larvæ in three pools of an estero, or small creek opening into Manila Bay, is capable of explanation although, because of osmotic difficulties, it is impossible to carry out the necessary experiments quantitatively on forms which do not live equally well in fresh and salt water.

The three analyses reported by Pearse are not strictly comparable, and in the calculation of the NaCl from the total Cl no standard of reference is given, nevertheless it follows from recalculation on the basis of Forchheimer, that the solutions dealt with must have been, as stated by Pearse, roughly, 2.6 per cent., 2.1 per cent. and 1.1 per cent. NaCl respectively.

As the larvæ were found in a tidal area where fresh and salt water meet, it is not probable that they were exposed continuously during their development to the amounts of NaCl given, but it is probable that they developed in a medium never free from this salt, and that despite the fact that .6 per cent. is ordinarily sufficient to prevent gastrulation.

Acclimatization to Osmotic Pressure.—A dilution of .85 per cent. NaCl (.25 per cent. less than the weakest solution reported) causes the death of 87 per cent. of the larvæ of *Rana pipiens* exposed to it for eighteen hours, whereas a solution of twice this strength kills 97 per cent. in three hours, and is therefore six times more fatal than the weaker solution. This fatality, however, depends on osmotic pressure, for both solutions brought about shrinkage, and an associated slowness and feebleness of reaction to touch. In the stronger solution these symptoms were more pronounced, and came on more quickly than in the weaker. Death resulted, therefore, probably more from dehydration than from the specifically poisonous effects of the NaCl.

These results led to an attempt at acclimatization by successively halving the .85 per cent. solution, until only one sixteenth its original strength. With this three series of tests were begun, involving fifteen larvæ. The results are given in tabular form as follows:

After	32	21	24	24	24	hours
in NaCl	.053125	.10625	.2125	.425	.85	per cent.
there were	15	14	12	10	0	survivors.

Time of acclimatization 101 hours.

Average strength of preparatory solution .199 per cent.

From control observations I found that 24 hours is just about the limit of endurance in the .85 per cent. solution, whereas without acclimatization 18 hours is the limit. Life, therefore, can be prolonged one third by a preliminary slow passage through weaker solutions. From this I conclude that the ability of amphibian larvæ to exist in sea water depends on their not being introduced into the stronger solutions too suddenly. This desideratum can certainly be fulfilled in an estero. These experiments leave entirely open the question of racial acclimatization which is probably of great importance.

The Antagonistic Effects of Calcium.—As Loeb[2] has repeatedly pointed out, very small quantities of Ca suffice to antagonize the poisonous effects of NaCl. Thus he found that in 100 c.c. of 5/8 M NaCl the eggs of *Fundulus* failed to develop, whereas when he added 4 c.c. of an M/64 $CaSO_4$ solution, 75 per cent. of the eggs formed embryos. From this it follows that one molecule of $CaSO_4$ is sufficient to antagonize 1,000 molecules of NaCl. It does not of course necessarily follow that this will prove true with other organisms, nor must we forget that other ions have been shown to antagonize the Na, but the antagonism of the Ca against the Na is so strong in the case of *Fundulus* that it is only natural to try this first in the case of the frog larva.

[1] Pearse, A. S., "Concerning the Development of Frog Tadpoles in Sea Water," *Philippine Journal of Science*, Vol. VI., No. 4, Section D.

[2] "Dynamics of Living Matter," p. 47.

The deleterious effect of a 1.7 per cent. NaCl solution to which .09 per cent. $CaSO_4$ had been added proved, as one might expect, greater than that of the pure NaCl solution. Even when diluted one half 93 per cent. of the larvæ died in 13 hours. However, preliminary treatment with more dilute solutions, even for a relatively short time, not only practically doubled the time during which the larvæ can endure the .85 per cent. solution, but only 7 per cent. died in 24 hours. In tabular form:

After	12	11	11	24	hours
in NaCl	.10625	.2225	.425	.85	per cent.
in $CaSO_4$	.005625	.01125	.0225	.045	per cent.
there were	15	15	15	14	survivors.

Time of acclimatization 34 hours.
Average strength of preparatory solution in Na .248 per cent.
Average strength of preparatory solution in Ca .013 per cent.

Comparing this result with the first acclimatization, it is seen that when Na and Ca are present roughly in the proportion of 50 to 1, the tadpoles may be acclimated to the .85 per cent. solution about three times as fast as in the absence of the Ca, and furthermore that 93 per cent. of the larvæ so treated can endure this solution for 24 hours, whereas, in the absence of Ca, none survive. Although the concentrations here dealt with are lower than those reported by Pearse, although not much lower than his weakest solution, the proportion of Na to Ca is, according to Forchheimer, identical.

Other Antagonisms.—In a series of investigations Loeb and Wasteneys[3] have demonstrated and measured the antagonistic effects of KCl and NaCl on *Fundulus,* so that in view of the fact that the findings with reference to Ca can be verified on the frog larva, it seems reasonable to assume similar relations for the K and Na. For Mg this is certainly true, although its antagonism to Na is much less marked, as the results given below show.

Comparison with the results with pure NaCl shows that the presence of the Mg enables the larva to withstand a solution of increasing concentration with average strength of .199 per cent. NaCl for 104 hours without a single death, whereas in the absence of Mg, 33 per cent. die in 101 hours. Both in the presence and absence of Mg, however, there were no survivors in the .85 per cent. solution after 24 hours, which shows that the Na–Mg antagonism is less pronounced than that between Na and Ca.

After	24	24	35	21	24	hours
in NaCl	.053125	.10625	.2125	.425	.85	per cent.
in $MgCl_2$	.0053125	.010625	.02125	.0425	.085	per cent.
there were	15	15	15	15	0	survivors.

Time of acclimatization 104 hours.
Average strength of preparatory solution in Na .199 per cent.
Average strength of preparatory solution in Mg .0199 per cent.

While these experiments give some insight into the conditions of survival for frog larvæ in sea water, the actual circumstances are probably not as simple as one might at first conclude, for granted an antagonistic action between Na and K, Na and Ca, and Na and Mg, it does not follow that in a solution in which all these salts are present, the total antagonistic effect toward Na could be represented by the formula, Na *vs.* (K + Ca + Mg) for ions capable of antagonizing the Na may antagonize each other. The existence of these "accessory" antagonisms has been demonstrated by Loeb and Wasteneys for *Fundulus.* In the case of the frog embryos I found an antagonistic action between Mg and Ca, for although both these ions antagonize the Na, yet a solution containing all three is a less

[3] *Biochemische Zeitschrift,* Bd. 31 and 32.

favorable one for the embryos than one containing only Na and Ca. The experiments on which this statement is based are tabulated below and can be compared with the earlier ones.

After	21	21	25	24	24	hours
in NaCl	.053125	.10625	.2125	.425	.85	per cent.
in $CaSO_4$	.0028125	.005625	.01125	.0225	.045	per cent.
in $MgCl_2$	.0053125	.010625	.02125	.0425	.085	per cent.
there were	15	15	15	15	12	survivors.

Time of acclimatization 120 hours.
Average strength of preparatory solution in Na .199 per cent.
Average strength of preparatory solution in Ca .0105 per cent.
Average strength of preparatory solution in Mg .0199 per cent.

Conclusion.—The ability of amphibian eggs to develop in sea water is dependent on the principle of ionic antagonism. In addition to this, however, their power of acclimatiza- plays an important rôle, for it not only enables them to withstand the passage from dilute to strong solutions, but the opposite process as well. Thus larvæ which have just reached a point where they fail to react to tactile stimuli in solutions which do not bring about dehydration, either because the solutions are too weak, or because the larvæ have been acclimated, will if transferred to fresh or distilled water recover in from one to two hours. If in addition to this we remember that the species found by Pearse is probably racially acclimated to the conditions under which it lives, his findings do not appear inexplicable.

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July 15, 1912

THE SCALES OF DERMOPHIS

IN SCIENCE, July 28, 1911, p. 127, I described the scales of the Asiatic amphibian *Ichthyophis,* pointing out their resemblance to certain fish scales. Early this year my wife and Mr. Earl Morris obtained a number of amphibians and reptiles at Quirigua, Guatemala,[1] and among them a specimen of the Cœciliid amphibian *Dermophis mexicanus* Peters. The scales of this animal are minute, oblong to suboval, superficially similar to those of *Ichthyophis.* The essential structure is also the same, but the cell-like areas, instead of being more or less brick-shaped, are long and narrow, usually pointed at the ends, as though compressed. The scales of *Ichthyophis* are finely granular, but *Dermophis* shows little of this. The structure of the *Dermophis* scale is even more like that of the eel *Synaphobranchus pinnatus* than is that of *Ichthyophis.*

On the whole, the correspondence in minute structure between the scales of the two Cœciliids examined, from opposite sides of the world, is very striking. It is evident that in the Cœciliids, as well as in the more primitive types of scaly fishes, scale-structure is extremely persistent. It is proper to say, however, that the two genera are otherwise rather close in structure, and it remains to be seen whether the scales of more divergent genera, such as *Cryptopsophis* or *Gymnophis,* present any marked differences.

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[1] These were very kindly determined for us by Dr. L. Stejneger. It may be worth while to give the list, as a contribution to the knowledge of their distribution: *Leptophis mexicanus* (Dum. & Bibr.), *Streptophorus atratus sebæ* (Dum. &

MINERAL CONTENT OF VOLANIC ASHES FROM KODIAK[1]

FOLLOWING the recent eruption from Mount Katmai (the first week of June, 1912) samples of the volcanic débris falling near the Agri- Bibr.), *Ameiva undulata* Gray, *Bufo valliceps* Weigm., *Hyla baudinii* Dum. & Bibr., *Dermophis mexicanus* Peters, *Spelerpes* (? *rufescens* Cope, condition poor).

[1] Published by permission of the Secretary of Agriculture.