overflowing so as to displace the air, and then completely empty it.

If the water is to be taken from a tap, let enough run to waste to empty the local lateral before sampling; if from a pump, pump enough to empty all the pump connections; if from a stream or lake, take the sample some distance from the shore, and plunge the sampling vessel a foot and a half below the surface during filling, so as to avoid surface scum.

In every case fill the demijohn nearly full, leaving but a small space to allow for possible expansion, and cork securely. Under no circumstances place sealing-wax upon the cork, but tie a piece of cloth firmly over the neck to hold the cork in place. The ends of the string may be afterwards sealed if necessary.

Bear in mind, throughout, that water analysis deals with material present in very minute quantity, and that the least carelessness in collecting the sample must vitiate the results. Give the date of taking the sample, as full a description as possible of the soil through which the water flows, together with the immediate sources of possible contamination.

STARFISHES OF THE INDIAN OCEAN.

BY DR. R W. SHUFELDT, TAKOMA, D. C.

BIOLOGICAL work of a very excellent character has within the last few years been accomplished in the Indian Seas through those employed on board H. M. Indian Marine Survey steamer, "Investigator," Commander C. F. Oldham, R.N., commanding. Much of this success is due to the labors of Mr. A. Alcock, Surgeon-Captain, I.M.S., and late Naturalist to the Survey.

Mr. Alcock has recently sent me from Calcutta a copy of his work, entitled "An Account of the Collection of Deep-Sea Asteroidea," from the region just mentioned — it being an extract from the *Annals and Magazine of Natural History* (Ser. 6, Vol. XI.) for February, 1893. From it, it would appear, that since the year 1885 many parts of the Indian Ocean, in waters varying from 100 fathoms to 1,000 fathoms and over, have been very profitably dredged by the naturalists of the "Investigator."

Mr. Alcock remarks, "A large collection of littoral and shallow-water forms [of starfishes] has also been made, but these are not here considered. If it be thought objectionable to have separated the deep-water from the shallow-water forms, it may be urged in justification that within the limits of Indian seas, so far as our experience at present goes, there is no instance of the two sections overlapping, and on another ground, that almost nothing has been published, and nothing else is promised, about the extremely interesting Asteroidea of the deeper waters of India. Of the basins into which these waters may conveniently be divided, the Bay of Bengal proper—the basin best explored by the dredge so far — gives us the smallest number of unknown species. Beyond the limits of the 30-fathom line it would seem as if the overwhelmingly muddy bottom of the bay presented conditions specially unfavorable to the existence of starfishes; and after passing this limit we usually dredge nothing until we reach true bathybial conditions in the middle of the bay" (pp. 73, 74).

On the Andaman side, however, in 561 fathoms of water, they met with *Brisinga*, and opposite to the Kistna and Godávari Deltas, in 500 to 700 fathoms, where the bottom was of a hardening clay, *Flabellum* (*japonicum* and *laciniatum*), *Bathyactis*, *Phormosoma*, and Spatangoids, *Pentagonaster*, again appeared. In the middle of the bay, with a bottom of accumulating *Globigerina*-ooze, the well-nigh cosmopolitan forms of *Pararchaster*, *Dytaster*, *Porcellanaster*, *Styracaster*, *Hyphalaster*, *Paragonaster*, *Zoroaster*, *Marsipaster*, *Hymenaster*, and *Freyella* rewarded the efforts of the dredger.

Peculiarly favorable to starfish-life is the enclosed basin of the Andaman Sea, which thus far, however, has only been examined up to 600 fathoms. Of twenty-one species here collected, no less than sixteen were new to science, including three very remarkable generic types. Eighteen species were dredged in the Laccadive Sea, and other very interesting localities were examined. Little, however, was added to our knowledge of the life-habits of the deep-sea starfishes, though "like some of the common reef-forms they must sometimes live in swarms, as, for instance, *Zoroaster carinatus*, of which over a score have been taken at one haul, *Pontaster hispidus*, of which about fifty have been dredged at the same time, and *Nymphaster florifer*, of which a 150 have come up on the tangle-bar."

The food of these deep-sea types seems mainly to be mollusks, prawns, and amphipods, and in some cases they gorge themselves with *Globigerina*-ooze. "A curious case of symbiosis, which has been observed too often to be a merely accidental association, occurs between *Dictyaster xenophilus* and an annelid."

Mr. Alcock's work forms a brochure of about fifty pages, with some good figures on plates, and throughout the whole he has followed the classification of Mr. Sladen, now well-known to the students of the Asteroidea, through their reading of it in those classical volumes, the "Challenger Reports," to which it was contributed.

THE USE OF POISONS AS FUNGICIDES AND INSECTICIDES.

BY L. R. TAFT, AGRICULTURAL COLLEGE, MICH.

ALTHOUGH copper sulphate has been used for many years for the destruction of the smut spores of wheat and oats, it is only about ten years since it was first employed upon fruit and similar crops as a fungicide, and for fully one-half of this period it was only used in an experimental way.

Its effects have proven so beneficial, however, that the fruit-growers, of the State of Michigan alone, will this year use several tons in combatting the various diseases that infest their crops.

The amount in time and materials expended in the use of fungicides in the United States must then reach many thousands of dollars, and it is very desirable that as much light as possible be secured upon the time and number of the applications that are necessary to obtain the best results, as well as upon the mixtures that will be most effective and economical. It has been clearly shown by many experiments that, to be most effective, the applications must be made early in the season, before the disease has obtained a foothold; but, as the number of sprayings required to hold the disease in check will depend upon such conditions as character of crop, season, and location, and the prevalence of the disease, it is doubtful if anything more than a general rule can be given, and this must be modified to suit the conditions.

Experiments have demonstrated that very small amounts of the salts of copper will destroy the spores of fungi, and have shown that the original formulæ for most of the fungicides were deficient in water, or, in other words, the mixtures were unnecessarily concentrated. Although, as now used, the strength has been greatly decreased, the limit has by no means been reached. The amount of copper sulphate in Bordeaux-mixture has been reduced from sixteen to six pounds for twenty-two gallons of water, and the experiments of the writer tend to show that for many diseases one or two pounds are fully as beneficial.

Two or three years ago most writers recommended some form of ammoniacal solution of copper carbonate, but, after a thorough trial, most fruit-growers have come to consider Bordeaux-mixture preferable to any of the ammonia-containing mixtures. The ammonia solutions were commended as being cheaper and easier to apply, but, in fact, the Bordeaux-mixture of the same strength is much less expensive; if properly strained it is not likely to clog the pump or nozzles; it is less easily washed from the plants; and it is not only less likely to injure the foliage, but it allows the arsenites to be used at the same time, thus forming a combined fungicide and insecticide, and the lime also prevents all injury from the arsenic.

For these reasons the Bordeaux-mixture is preferable, and its use should be commended.

This lime-mixture covers the plants with a sort of whitewash, and, although this is in one way objectionable, in another, from the consumers' standpoint at least, it is preferable to some of the clear solutions, which, although they contain fully as much poison, are not very noticeable upon the plants.

Fruits sprayed within a few days of the time of gathering would in one case not be saleable, and in the other, although