favor of the lambs fed on nitrogenous food, it is when we come to compare the amount of gain in relation to the amount and cost of the food consumed that the most striking figures are brought out. Both in the amount of food consumed for one pound of gain, and the cost of gain per one hundred pounds, the advantage is very markedly in favor of lot IV, the lot fed on nitrogenous food. It costs a little more than a cent and a half per pound, or twenty-six per cent more to put a pound of gain upon the lambs that were fed on corn, timothy hay, and roots than it did to put a pound of gain on those that were fed wheat bran, cotton-seed meal, clover hay, and roots.

The lambs were shorn Nov. 15, or ten days before the beginning of the experiment. They were shorn again the day before they were slaughtered, so that the wool obtained was the growth of 160 days. The weight of the wool from both lambs in each lot was, lot III, 4.25 pounds; lot IV, 7.31 pounds; lot V, 6.63 pounds; lot VI, 6.19 pounds;—the last three lots showing an increase over lot III of 72, 56, and 46 per cent respectively. This coincides with the results of the experiments last year, in that nitrogenous food seems to largely affect the growth of wool. It seems to show further that even a small increase in the nitrogenous matter of a ration has a decided influence on the growth of the wool, for lots V and VI, whose ration was intermediate in character, gave very nearly as much wool as lot IV. In the experiments of 1888, already referred to, the percentage was not so great in favor of the lambs fed on nitrogenous food.

The lambs were slaughtered on April 25. The blood was carefully caught in a clean pail, and it and all the important internal organs were weighed. The carcasses were hung up in a cool place to stiffen for two days, and were then cut up, and the parts carefully examined. Before they were taken down, however, they were weighed and most carefully inspected by the different members of the staff. The most striking difference that was apparent, as the carcasses hung upon the hooks, and after they were cut up, was the evident leanness of the two belonging to lot IV, which had been fed nitrogenous food. The kidneys were not covered, and there was very little loose fat next the skin, while in all the other carcasses the kidneys were more or less completely covered, and there was a layer of tallow of greater or lesser thickness between the skin and body. The carcasses of lot III had the most of this tallow. The same thing is shown in the amount of caul fat and kidney fat. While an expert butcher would have undoubtedly selected the carcasses of lots V and VI as furnishing the most saleable mutton, the carcasses of lot IV had little or no unpalatable adipose matter, and those of lot III showed much the largest percentage of waste fatty matter about the root of the tail and in the flanks.

The weight of evidence of all of the experiments at Cornell, together with results obtained by other experimenters in the same field, seems to show: that corn, as an exclusive grain ration, does not give the best results, either in amount, quality or economy of production, when fed to growing or fattening animals; that the amount of water drank, especially in the case of these lambs, is a pretty certain indication of the rate of gain; and that the production of wool is very greatly dependent upon the nitrogen in the ration.

The value of the manure made from the animals fed is a matter of prime importance, to all eastern farmers at least. And often the manure left on the farm represents a large part, if not the whole, of the profit made from feeding a lot of animals. For this reason there were calculated the manurial value of the rations fed the different lots. From this it appeared that while the first cost of the ration of the nitrogenous fed sheep was larger than that of the carbonaceous, yet when the value of the manure is subtracted, the cost of the former is less than half of the latter.

PEARL OYSTERS.

THE presence of nodules or tubercles on the interior surface of the shells or valves of lamellibranch (bivalve) mollusks is of frequent occurrence. These excrescences are nacreous or otherwise, according to the character in this respect of the shell in which or upon which they occur. They are found alike in fresh-water and marine species. In the pond and river mussels they are chiefly due to interior causes; in marine forms, like the cockles, mussels, the scallops, etc., these formations are generally traceable to exterior causes. It is often the case that specimens of the large scallop of the New England coast are so burrowed into by a species of sponge that nearly the entire inside surface of the valves will be roughened with sharp, thickly-set pustulæ. In all the marine species in which those nodules occur it will usually be found that the substance of the shell has been bored into from the outside by either a species of pholad or lithodomus.

Neither of these forms are, properly speaking, either parasites or commensals. They are, more definitely, "domiciliares," as stated by Mr. Robert E. C. Stearns of the Smithsonian Institution, and excavate their burrows, not for the purpose of getting at the softer parts of the mollusk upon whose shell they have "squatted" in order to use said softer parts as food, but solely for the purpose of a residence or domicile.

The burrows of these shell-boring pholads and lithodomi are at first quite small, increasing in size in the same ratio as the burrower increases in age or in growth. After a while the depth of the boring is equal to the thickness of the shell in which it has been made, and the occupant of the latter, in order to keep his own shell intact and maintain the integrity of his own domicile, commences depositing layer upon layer of nacreous or porcellaneous matter, as the case may be. In keeping pace with the continued encroachments of the domiciliary squatter upon the outside, this deposit finally becomes a more or less conspicuous protuberance.

Sometimes these nodules or tubercles are due to some foreign inorganic matter, a particle getting in between the mantle of the mollusk and the inner surface of its shell. In such cases it is, we may say, at once plastered over, and thus fixed upon the surface of the valve. Free concretions, i.e., unattached or non-adherent nodules, are, as is well understood, caused by some particle, organic or inorganic, becoming in some way lodged exclusively in the soft parts of the body of the mollusk, and so far away from the surface of the shell as not to admit of its being cemented to it.

No doubt many of the mollusca, both gastropod and lamellibranch, contain or are inhabited by true parasites. In certain species of fresh-water mussels a species of water mite has been detected, and sometimes thread worms and other forms occur.

A small species of crab, an epicurean no doubt, finds a salubrious habitation in the common oyster, but parasites of any considerable size appear to be rather rare. Besides the species above referred to, another small crab is sometimes found in the common mussel and the large scallop before mentioned. It is doubtful, however, whether these crabs are really parasites or only commensals, though probably the former.

There is, however, evidence of the occurrence of fishes of two species as parasites in the true pearl oyster, or mother-of-pearl shell, not by the presence of the living fish, or even by dead specimens of "fish in the flesh," if we may use so convenient a paradox, but by their entombed remains in the form of nacreous nodulæ or tubercles on the shells or valves of the said mollusk.

At a meeting of the Zoological Society of London June 1, 1886, Dr. Günther exhibited a specimen of a small fish of the genus *fierasfer* embedded in a pearl oyster, and said: "This specimen is an old shell, in which there is imbedded, behind the impression of the attractor muscle, a perfect individual of a fish belonging to the genus *fierasfer*. The fish is covered by a thin layer of pearl substance, through which not only the general outlines of the body but even the eye and the mouth can be seen. The parasitic habits of *fierasfer* are well known. The fish, instead of introducing itself into the cavity between the two halves of the mantle, penetrated between the mantle and the shell, causing irritation to the mollusk. which the latter resented by immediately secreting the substance with which the intruder is now covered. It is remarkable to note that the secretion must have taken place in a very short time, at any rate before the fish could be destroyed by decomposition."

After entering the shell, which of course must be at such time as the valves are partially open or gaping, these fishes find no obstruction to their course as they push their way towards the interior between the mantle and the smooth inner surface of the valves until they approach the adductor muscle, and here they find a barrier which most likely causes them to expend somewhat greater ac-

tivity or energy, and consequently in a correspondingly increased degree disturb the serenity if not the structural economy of the oyster.

Having reached thus far, the invader is in the immediate vicinity of, if not the seat of intellect, the centre of sensitiveness. The deposit of nacre in such instances must be very rapid; and it is quite possible that the unwelcome explorer is not only enshrouded and entombed in pearl, but previously drowned in a pearlaceous flood, for it may be reasonably presumed that the annoyance caused by its presence must be exceedingly great, and likely to induce a copious flow of nacreous lymph at the point and in the region of greatest irritation. It is evident that the deposition and induration are sufficiently rapid to inclose the parasite before decomposition has taken place.

THE WORLD'S FAIR OF 1892.

AMONG those who have volunteered suggestions as to the scope of the exhibition to be held in 1892, is Mr. Edward Atkinson. Although it may be said that Mr. Atkinson overlooks the main cause for the holding of such an exhibition, which is that it serves merchants and manufacturers with a good means of advertising, yet as his letter contains so many good suggestions likely to improve the tone of the exhibition we quote literally from it. Mr. Atkinson writes: —

I have watched with some interest the course of the discussion on the exhibition proposed for 1892. I have had a little experience in such matters, and have given some thought to the subject. . . . It seems to me that the day has gone by for a great world's fair or bazaar, in which all kinds of goods and wares may be displayed, largely for purposes of advertising them, without much system or method and without any distinctive purpose in the general scope or plan of the exhibition, except to make a great show. Any one who desires to study or observe such goods and wares can find a better exhibition in the shop windows than has ever yet been put together in a world's fair or bazaar. Such fairs are cumbrous, costly, tiresome, and unsatisfactory. The time was when they were novel, interesting, instructive, and useful. The diplomas are, as a rule, of little or no value. I exhausted the dictionary at the Centennial of 1876 in trying to vary the diplomas which we gave substantially to every one who made an exhibit in our group, and the few who were refused afterwards appealed to the higher powers, and obtained their diploma or certificate of excellence. . . . There was, however, one conspicuous exception in the Centennial to the generally commonplace character or want of distinct purpose in the method of exhibiting. The Kansas and Colorado exhibit of natural products and resources laid the foundation of the progress of agriculture and mining in that section.

When I was called upon to advise how the exhibition at Atlanta should be laid out and directed, my first conception was to bring together every thing that could be exhibited or made known in regard to cotton, not only in respect to the fibre but in respect to the seed and the plant. Presently it became apparent to me that such an exhibition would tend more and more to the concentration of Southern efforts upon cotton only and would stand in the way of the diversity of industry which that special section especially needed; I therefore conceived the plan of imitating the Kansas and Colorado exhibit, and advised the directors to interest the Southern railroads, the owners of land, and the owners of mining property in bringing together that wonderful collection of timber, minerals, and the products of the soil which really formed the most important part of the so-called Cotton Exposition. . . . When such men as the Inmans and others assure me that the effect of that exhibition and the carrying out of that specific suggestion made the real starting-point in the progress of the South in all the arts which are now gaining so rapidly, and made known to the Southerners themselves, as a body, the magnitude of their own resources, which had hardly been conceived even by the few, I can no longer resist the conclusion that mine was a happy thought, and that I did contribute in considerable measure to the progress and prosperity of the Southern States. Of course, in the nature of the case, the progress would ultimately have been made, but the great and early start is dated from the Atlanta Exposition.

The motive of the exhibition in 1892 is that the year recalls the date of the discovery of America by Europeans four hundred years ago. Ought not the motive of such an exhibition to be the progress in human welfare in four hundred years, through the application of science and invention to the pursuits of peace? Ought not such an exhibition to illustrate the interdependence of nations, the growth of commerce, and of modern industry, — prophetic of the time when war shall be forbidden at the command of commerce? Four hundred years ago the invention of gunpowder had only begun to promote equality in the conditions of men; it had only begun to make the power of the serf equal to that of the seignior; it had only begun to do away with the dominion of privilege, and to establish the dominion of human rights; it had only begun to alter the relations of men in the exchange of services from distribution according to status to distribution according to contract. The invention of printing had only begun to diffuse intelligence; it had only begun to make possible and to establish a system of common law; it had only begun to make known to the poor and feeble that He who created the world ruled all things well and recognized no difference among men because of race, birth, condition, or color. The long struggle for equal rights, first taking the form of resistance to superstition, and of wars waged nominally on religious grounds, was soon converted into a system of war waged by nations in order that the so-called civilized nations of Europe might each on its own behalf dominate sections of the new world, and control by force and by colonization the commerce of the continents or of parts of continents secured by war for the sole benefit of the European countries, each for itself, by whom this dominion had been gained.

It is only within the last century of the four, or only since the physiocrats of France first entered upon the study of the relation of men to each other, and since the publication of the "Wealth of Nations," by Adam Smith in 1776, that the true function of trade and commerce has begun to be conceived among civilized men. Even at the present time the continent of Europe, which, if we separate the uninhabited portions of Norway, Sweden, and Russia, is about equal in area to the area of the United States, omitting Alaska, is divided up into substantially nineteen separate empires or States, each cut off from the other by barriers to mutual service and restrictions upon their traffic, at which barriers taxes are levied upon commerce; the avails of such taxes being more than expended in the support of armies and navies which, except for these barriers to mutual service, would not be required. Witness on the other hand, the growth and progress of this nation. The freedom from obstruction to mutual service among its citizens which was established in our organic law, in that provision of the Constitution which forbids any interference with commerce between the States, is without question the rule to which we owe more than to anything else, the preservation of the Union and the freedom from the blood tax, as well as the money tax of a standing army.

My ideas run away with me in trying to give my conception of what the exhibition of 1892 might be. My conception is yet somewhat vague. My general idea is that either by way of examples, of pictures, of graphic illustrations, and of figures, one and all combined, so far as may be, the exhibition should show the progress of modern art and industry from the pre-historic type, or from the type of 1492, down to the present day.

For instance, the art of weaving is older than history. The prehistoric loom was the same as the loom on which nine-tenths of the material for clothing the people of China is now woven — the same as the hand-loom which even to-day is in operation in the southern mountain valleys of "the land of the sky," in Kentucky, in Tennessee, and in the Carolinas — the same as the hand-loom on which the French *habitans* of Lower Canada still choose to make the fabrics with which they are clothed. It would be easily possible to give the examples in action of the whole art of weaving within the limits of a small section of a great exhibition building, the Chinese, African, South American, homespun American, and the modern, all in contrast; the Arab weaving shawls, the Daghestan carpets, the Navajo Indian blankets, etc., on the walls of which section could be pictured geographically the relative demand and supply of the different sections of the globe for the products of the loom.

The art of spinning could be illustrated in the same way; . . .