vented the expenditure of great sums of money on the State canal in the first instance, and upon the Pawnee Pass reservoir project in the second.

Survey data seem to be in great demand as unimpeachable testimony in the legal controversies that have arisen in this State in regard to irrigation matters. A most notable instance is the case of the Colorado and Southern Railroad vs. the Denver Union Water Company, in which the sum of \$100,000 was involved.

Data obtained by the Survey in regard to the amount of water power available at certain places have influenced the plans of the Glenwood Springs Light and Power Company, the New Century Light and Power Company, and also proposed power companies on Clear and St. Vrain's creeks. None of these projects has yet been carried to a conclusion, but some of them will undoubtedly be eventually constructed.

Colorado cities seeking a suitable water supply have frequently consulted data obtained by the Survey. In the case of Durango, in southwestern Colorado, the discharge of Florida River was especially studied in order to ascertain whether a gravity water system would be feasible at that point.

The location of various manufacturing industries has been determined by reports from Survey engineers on the available water supply. Conspicuous instances of this are the construction of the American Beet Sugar Company's plant at Rocky Ford and the erection of the sugar factory at Loveland.

THE LIFE OF A FOREST.*

By GIFFORD PINCHOT.

THE history of the life of a forest is a story of the help and harm which the trees receive from one another. On one side every tree is engaged in a relentless struggle against its neighbors for light, water, and food, the three things trees need most. On the other side, each tree is constantly working with all its neighbors, even those which stand at some distance, to bring about the best condition of the soil and air for the growth and fighting power of every other tree.

The life of a community of trees is an exceedingly interesting one. A forest tree is in many ways as much dependent upon its neighbors for safety and food as are the inhabitants of a town upon one another. The difference is that in a town each citizen has a special calling or occupation in which he works for the service of the commonwealth, while in the forest every tree contributes to the general welfare in nearly all the ways in which it is benefited by the community. A forest tree helps to protect its neighbors against the wind, which might overthrow them, and the sun, which is ready to dry up the soil about their roots or to make sun cracks in their bark by shining too hotly upon it. It enriches the earth in which they stand by the fall of leaves and twigs, and aids in keeping the air about their crowns, and the soil about their roots, cooler in summer and warmer in winter than it would be if each tree stood alone. With the others it forms a common canopy under which the seedlings of all the members of this protective union are sheltered in early youth, and through which the beneficent influence of the forest is preserved and extended far beyond the spread of the trees themselves. But while this fruitful co-operation exists, there is also present, just as in a village or a city, a vigorous strife for the good things of life. For a tree the best of these, and often the hardest to get, are water for the roots and space and light for the crown. In all but very dry places there is water enough for all the trees, and often more than enough, as for example in the Adirondack forest. The struggle for space and light is thus more important than the struggle for water, and as it takes place above ground it is also much more easily observed and studied.

Light and space are of such importance because the leaves cannot assimilate or digest food except in the presence of light and air. The rate at which a tree can grow and make new wood is decided chiefly by its ability to assimilate and digest plant food. This power depends upon the number, size, and health of the leaves, and these in turn upon the amount of space and light which the tree can secure.

The story of the life of a forest crop is then largely an account of the competition of the trees for light and room, and, although the very strength which enables them to carry on the fight is a result of their association, still the deadly struggle, in which the victims are many times more in number than those which survive, is apt alone to absorb the attention. Yet the help of the trees to one another is always going quietly on. Every tree continually comforts and assists the other trees, which are its friendly enemies.

The purpose here is to follow the progress of a forest crop of uniform age from the seed through all the successive phases of its life until it reaches maturity, bears seed in its turn, and finally declines in fertility and strength until at last it passes away and its place is filled by a new generation. The life history which we are about to follow, as it unfolds itself through the course of several hundred years, is full of struggle and danger in youth, restful and dignified in age. The changes which pass over it are vast and full of the deepest interest, but they are very gradual. From beginning to end one stage melts insensibly into the next. Still, in order to study and describe them conveniently, each stage must have limits and a name.

A very practical way of classifying trees according

to size is the following: Young trees which have not yet reached a height of 3 feet are *seedlings*. They are called seedlings in spite of the fact that any tree, of whatever age, if it grew from a seed, is properly called a seedling tree. Trees from 3 to 10 feet in height are *small saplings*, and from 10 feet in height until they reach a diameter of 4 inches they are *large saplings*. *Small poles* are from 4 to 8 inches in diameter, and *large poles* from 8 to 12 inches in diameter. Trees from 1 to 2 feet through are *standards*, and, finally, all trees over 2 feet in diameter are *veterans*.

It is very important to remember that all these diameters are measured at the height of a man's chest, about 4 feet 6 inches from the ground. In forestry this is, roughly speaking, the general custom.

Let us imagine an abundant crop of tree seeds lying on the ground in the forest. How they came there does not interest us at present; we do not care to know whether they were carried by the wind, as often happens with the winged seeds of many trees, such as pines and maples, whether the squirrels and birds dropped and planted some of them, as they frequently do acorns and chestnuts, or whether the old trees stood closely about and sowed the seeds themselves. We will suppose them to be all of one kind, and to be scattered in a place where the soil, the moisture, and the light are all just as they should be for their successful germination, and afterward for the later stages of their lives. Even under the best conditions a considerable part of the fallen seed may never germinate, but in this case we will assume that half of it succeeds.

As each seed of our forest germinates and pushes its first slender rootlet downward into the earth, it has a very uncertain hold on life. Even for some time afterward the danger from frost, dryness, and excessive moisture is very serious indeed, and there are many other foes by which the young seedlings may be overcome. It sometimes happens that great numbers of them perish in their earliest youth because their roots cannot reach the soil through the thick, dry coating of dead leaves which covers it. But our young trees pass through the beginning of these dangers with comparatively little loss, and a plentiful crop of seedlings occupies the ground. As yet, however, each little tree stands free from those about it. As yet, too, the life of the young forest may be threatened or even destroyed by any one of the enemies already mentioned, or it may suffer just as severely if the cover of the older trees above it is too dense. In the beginning of their lives seedlings often require to be protected by the shade of their elders, but if this protection is too long continued they suffer for want of light, and are either killed outright or live only to drag on stunted and unhealthy lives.

The crop which we are following has had a suitable proportion of shade and light during its earliest years, and the seedlings have spread until their crowns begin to meet. Hitherto each little tree has had all the space in the air and soil that it needed for the expansion of its top and roots. This would have been entirely good, except that meanwhile the soil about the trees has been more or less exposed to the sun and wind, and so has become dryer and less fertile than if it had been under cover, and consequently the growth has been slow. But now that the crowns are meeting, the situation becomes wonderfully changed. The soil begins to improve rapidly, because it is protected by the cover of the meeting crowns and enriched by the leaves and twigs which fall from them.

In so far the conditions of life are better, and in consequence the growth, and more especially the height growth, begins to show a marked increase. On the other hand, all the new strength is in immediate demand. With the added vigor which the trees are now helping each other to attain, comes the most urgent need for rapid development for the decisive struggle at hand. The roots of the young trees contend with each other in the soil for moisture and the plant food which it contains, while in the air the crowns struggle for space and light. The latter is by far the more important battle. The victors in it overcome by greater rapidity of growth at the ends of the branches, for it is by growth there, and there only, that trees increase in height and spread of crown. Growth in this way was going on unchecked among the young trees before the crowns met, but now only the upward-growing branches can develop freely. The leaves at the ends of the side branches have now less room and, above all, less light, for they are crowded and thrust aside by those of the other trees. Very often they are bruised by thrashing against their neighbors when the wind blows, or even broken off while still in the bud. Leaves exposed to such dangers are unhealthy. They transpire less than the healthy undisturbed leaves of the upper part of the crown, and more and more of the undigested food from the roots goes to the stronger leaves at the top as the assimilating power of the side leaves dwindles with the loss of light. The young branches share the fortunes of their leaves and are vigorous or sickly according to the condition of the latter. For this reason the growth of the tops increases, while that of the lower lateral branches, as the tops cover them with a deeper and deeper shade, becomes less and less. Gradually it ceases altogether, and the branches perish. This process is called natural pruning, and from the time when it begins the existence of the young forest, unless it should be overtaken by fire or some other great calamity, is practically secure.

At this time, as we have seen, the crowns of all the young trees are growing faster at the tops than at the sides, for there is unlimited room above. But some

are growing faster than others, either because their roots are more developed or in better soil than those of the trees about them, because they have been freer from the attacks of insects and other enemies, or for some similar reasons. Some trees have an inborn tendency to grow faster than others of the same species in the same surroundings, just as one son in a family is often taller than the brothers with whom he was brought up.

Rapid growth in height, from whatever cause it proceeds, brings not only additional light and air to the tree which excels in it, but also the chance to spread laterally, and so to complete the defeat of its slower rivals by overtopping them.

Those trees which have gained this advantage over their neighbors are called dominant trees, while the surviving laggards in the race are said to be overtopped when they are hopelessly behind, and retarded when less badly beaten. Enormous numbers of seedlings and small saplings are suppressed and killed during the early youth of the forest. In the young crop which we are following many thousands perish upon every acre. Even the dominant trees, which are temporarily free when they rise above their neighbors, speedily come into conflict with each other as they spread, and in the end the greater portion is overcome. It is a very deadly struggle, but year by year the differences between the trees become less marked. Each separate individual clings to life with greater tenacity, the strife is more protracted and severe, and the number of trees which perish grows rapidly smaller. But so great is the pressure when dense groups of young trees are evenly matched in size and rate of growth that it is not very unusual to find the progress of the young forest in its early stages almost stopped and the trees uniformly sickly and undersized, on account of the crowding.

The forest we have been following has now passed through the small-sapling stage, and is composed chiefly, but not exclusively, of large saplings. Among the overtopped and retarded trees, which often remain in size classes which the dominant trees have long since outgrown, there are still many low saplings. Even between the dominant trees, in a healthy forest, there are always great differences. Increase in height is now going on rapidly among these high saplings, and either in this stage or the next a point is reached when the topmost branches make their longest yearly growth, which is one way of saying that the trees make their most rapid height growth as large saplings or small poles. Later on, as we shall see, these upper branches lengthen much more slowly, until, in standards and veterans, the growth in height is small, and in very old trees finally ceases altogether.

While the trees are pushing up most rapidly, the side branches are most quickly overshadowed, and the process of natural pruning goes on with the greatest vigor. Natural pruning is the reason why old trees in a dense forest have only a small crown high in the air, and why their tall, straight trunks are clear of branches to such a height above the ground. The trunks of trees grown in the open, where even the lower limbs have abundance of light, are branched either quite to the ground or to within a short distance of it. But in the forest not only are the lower side branches continually dying for want of light, but the tree rids itself of them after they are dead, and so frees its trunk from them entirely. When a branch dies the annual layer of new wood is no longer deposited upon it. Consequently the dead branch, where it is inserted in the tree, makes a little hole in the first coat of living tissue formed over the live wood after its death. The edges of this hole make a sort of collar about the base of the dead branch, and as a new layer is added each year they press it more and more tightly. So strong does this compression of the living wood become that at last what remains of the dead tissue has so little strength that the branch is broken off by a storm or even falls of its own weight. Then in a short time, if all goes well, the hole closes, and after a while little or no exterior trace of it remains. Knots, such as those which are found in boards, are the marks left in the trunk by branches which have disappeared.

While the young trees are making clean trunks so rapidly during the period of greatest yearly height growth they are also making their greatest annual gains in diameter, for these two forms of growth generally culminate about the same time. A little later, if there is any difference, the young forest's highest yearly rate of growth in volume is also reached. For a time these three kinds of growth keep on at the same rate as in the past, but afterward all three begin to decrease. Growth in diameter, and in volume also, if the trees are sound, goes on until extreme old age, but height growth sinks very low while the two others are still strong. For many years before this happens the struggle between the trees has not been so deadly, because they have been almost without the means of overtopping one another. When the end of the period of principal height growth is reached the trees are interfering with each other very little, and the struggle for life begins again in a different way. As the principal height growth ceases, and the tops no longer shoot up rapidly above the side branches, the crowns lose their pointed shape and become comparatively flat. The chief reason why trees stop growing in height is that they are not able to keep the upper parts of their crowns properly supplied with water above a certain distance from the ground. This distance varies in different kinds of trees, and with the health and vigor of the tree in each species, but there is a limit in every case above which the water does

* Abstracted from Farmers' Bulletin No. 173 of the U. S. Dept. of Agriculture.

not reach. The power of the pumping machinery, more than any other quality, determines the height of the tree.

Now that the tree can no longer expand at the top, it must either suffer a great loss in the number of its leaves or be able to spread at the sides; for it is clear that not nearly so many leaves can be exposed to the light in the flattened crown as in the pointed one, just as a pointed roof has more surface than a flat one. It is just at this time, too, that the trees begin to bear seed most abundantly, and it is of the greatest importance to each tree that its digestive apparatus in the leaves should be able to furnish a large supply of digested food. Consequently the struggle for space is fiercely renewed, only now the trees no longer attempt to overtop one another, having lost the power, but to crowd one another away at the sides. The whole forest might suffer severely at this point from a deadlock such as sometimes happens in early youth were it not for the fact that the trees, as they grow older, become more and more sensitive to any shade. Many species which stand crowding fairly well in youth can not thrive in age unless their crowns are completely free on every side. Each of the victors in this last phase of the struggle is the survivor of hundreds (or sometimes even of thousands) of seedlings. Among very numerous competitors they have shown themselves to be the best adapted to their surroundings.

Natural selection has made it clear that these are the best trees for the place. These are also the trees which bear the seed whence the younger generations spring. Their offspring will inherit their fitness to a greater or less degree, and in their turn will be subjected to the same rigorous test, by which only the best are allowed to reach maturity. Under this sifting out of the weak and the unfit, our native trees have been prepared through thousands of generations to meet the conditions under which they must live. This is why they are so much more apt to succeed than species from abroad, which have not been fitted for our climate and soil by natural selection.

The forest which we saw first in the seed has now passed through all the more vigorous and active stages of its life. The trees have become standards and veterans, and large enough to be valuable for lumber. Rapid growth in height has long been at an end, diameter growth is slow, and the forest as a whole is increasing very little in volume as time goes on. The trees are ripe for the harvest.

Out of the many things which might happen to our mature forest, we will only consider three.

In the first place, we will suppose that it stands untouched until, like the trees of the virgin forest, it meets its death from weakness and decay.

The trees of the mature primeval forest live on, if no accidents intervene, almost at peace among themselves. At length all conflict between them ends. The whole power of each tree is strained in a new struggle against death, until at last it fails. One by one the old trees disappear. But long before they go the forerunners of a new generation have sprung up wherever light came in between their isolated crowns. As the old trees fall, with intervals often of many years between their deaths, young growth of various ages rises to take their place, and when the last of the old forest crop has vanished there may be differences of a hundred years among the young trees which succeed it. An even-aged crop of considerable extent, such as we have been considering, is not usual in the virgin forest, where trees of very different ages grow side by side, and when it does occur the next generation is far less uniform. The forest whose history has just been sketched was chosen, not because it represents the most common type of natural forest, but because it illustrates better than any other the progress of forest growth.

The wood of a tree which dies in the forest is almost wholly wasted. For a time the rotting trunk may serve to retain moisture, but there is little use for the carbon, oxygen, and hydrogen which make up its greater part. The mineral constituents alone form a useful fertilizer, but most often there is already an abundance of similar material in the soil. Not only is the old tree lost, but ever since its maturity it has done little more than intercept, to no good purpose, the light which would otherwise have given vitality to a valuable crop of younger trees. It is only when the ripe wood is harvested properly and in time that the forest attains its highest usefulness.

AQUATIC FURS USED BY HATTERS.*

By CHARLES H. STEVENSON.

DURING the seventeenth and eighteenth centuries an important if not principal use of aquatic furs in Europe was in making fashionable hats, commonly called beaver hats, beaver fur being the chief material in their make-up. The general adoption of the silk hat about sixty years ago resulted in greatly reducing the quantity of aquatic furs used by hatters, but those manufacturers are yet large consumers of these articles for the production of fine grades of soft hats.

The principal felting furs among the aquatics are nutria, muskrat, beaver, fur-seal, otter, and mink, named in the order of the extent to which they are now used. Rabbit, cony, and hare furs are used far more extensively than all the foregoing combined, owing to their cheapness, but are less desirable than most varieties of aquatic furs. Hatters' furs are both cut and blown, the former being taken from the whole

skins, and the latter from small pieces, clippings, roundings, and other waste obtained in cutting skins for sewing into garments.

The choicest felting fur is that of the beaver; but its high cost limits its use in hat-making. A felt hat of average size and weight made of fur cut from choice beaver pelts could not be made for less than \$500 per dozen, and no demand exists for such expensive goods. But manufacturers receive a quantity of beaver cut from damaged skins of little value as dressed furs and also considerable blown from clippings and the waste from cutting skins into garments. The choicest beaver fur for hatters' purposes is obtained from the cheeks of the animal, with that from the belly, the back, and sides, following in the order named.

Beaver clippings sell for about \$1 to \$1.25 per pound, and the fur, when blown free from hair and impurities, sells for \$8 or \$10 per pound. Cut beaver has been sold as high as \$224 per pound by brokers yet in the business. The quantity of beaver fur used by hat manufacturers throughout the world averages about 6,000 pounds annually. It is made into very light soft hats, which sell wholesale at about \$80 or \$90 per dozen. These are very durable, and if occasionally cleaned or dyed may be worn almost indefinitely. A small demand still exists for the old-fashioned beaver-napped hats, shaped somewhat like the present style of silk hat, being the fashionable headgear for the guards on drags and coaches, and to a small extent for ladies' riding hats.

The next highest grade of fur used by hat-manufacturers is nutria, which is the standard choice fur for making into soft felt hats. It is estimated that about one-third of the total product of nutria skins are cut for hatters' use, and in addition the hat-manufacturers receive large quantities of blown fur from manufacturers' clippings. Nutria is very nearly as desirable as beaver for felting, selling at present for about 80 per cent of the value of the latter, whereas in the dressed-fur trade it is worth only 30 per cent as much as an equal area of beaver fur. During the past twenty-five years the average value of cut and blown nutria fur has ranged between \$2.25 and \$7.50 per pound. In 1877 it was \$5.50, and gradually decreased to \$2.25 in 1886; it increased to \$7.50 in 1897, and in 1900 it averaged \$6.50 per pound. Single sales have been made as high as \$14 per pound. The total product of nutria fur used in hat-manufacturing in 1900 is estimated at 80,000 pounds, valued at \$520,000. It is claimed that a single manufacturer in Philadelphia has at times over a million nutria skins in warehouse.

Otter ranks next in grade among felting furs, but only a small quantity of this kind is used, and that is obtained from fur-cutters' waste. The clippings and waste sell for about 45 cents per pound, and the cut and blown fur for about \$3.50 per pound. The quantity used by hat manufacturers annually probably approximates 700 pounds.

Muskrat fur is used extensively in hat-making, the whole skin as well as cutters' waste being utilized. Like beaver fur, it is assorted into three grades—backs, sides, and bellies—on account of difference in color and texture. The belly fur is the choicest and is used for making light or pearl hats. During the last twenty-five years the price has ranged from \$1.80 to \$3.25 per pound, averaging about \$2. In 1876 it was \$2.25, from which it varied little till 1890, when it began to increase, reaching \$3.25 in 1892, and since then it has steadily decreased to the present price \$1.80 per pound. The cutters' waste sells for 35 to 40 cents per pound and the blown fur for \$1.30 to \$2 per pound. The standard mixed grade of blown muskrat fur usually sells for 30 or 40 cents less per pound than the belly fur, while dyed muskrat sells usually for one-third the price of cut belly, or about 60 cents per pound.

A small quantity of mink fur is used by the hat-manufacturers, the amount not exceeding 1,500 pounds annually, obtained entirely from cutters' waste, no whole skins whatever being used for this purpose. Mink fur is rather poor for felting, as may be inferred from the price at which it sells, the clippings fetching about 15 cents and the blown fur about \$1.10 per pound, or only one-sixth the price of beaver.

The cheapest aquatic fur received by the hatters is that of the fur-seal, of which probably 5,000 pounds are used annually. This is obtained almost exclusively from cutters' waste of dyed clippings, and when cut and blown sells for about 75 cents per pound.

The preparation of all these furs for felting purposes is practically the same in each case. Preparatory to cutting them from the whole skins, the pelts are scoured thoroughly with soap water to remove the grease and other impurities, then they are properly dried and plucked, each one of these several processes being performed in much the same manner as in the fur-dressing establishments, except that it is done with greater expedition and less care. The overhairs are of no value in felting, and are sold as stuffing in upholstery, for plasterers' use, etc. The plucked skins are next carotated, consisting in moistening the fur with a solution of quicksilver and nitric acid or chloride of mercury, and then spreading them out flat to dry. This is done either in the open air or in rooms heated by steam, according to the color desired.

When dried in the open air the fur becomes whitish, and when dried by subjection to steam or other artificial heat it assumes a yellow carrot-like hue. This explains the abbreviations W. C. (white carrot) and Y. C. (yellow carrot) always given in connection with the designation of each kind of felting fur. In the preparation of beaver and some other furs, the carrot-

ing is occasionally omitted, but this raw stock does not felt so readily and is usually mixed with properly carotated fur.

After drying, the carotated skins are brushed by holding each one for a few seconds against a revolving wheel studded with quills. This is for the purpose of removing all dust and to straighten the fur so that it may be readily cut from the skin. Originally the cutting was done by manual labor, a pair of shears being used, and later by means of an ingenious mechanism giving a chopping motion to a vertically mounted knife. At present a much better machine is used, which with great rapidity cuts the pelt from the fur in little narrow strips about one-sixteenth of an inch in width and equaling in length the width of the skin. These strips of coriaceous membrane fall into a receptacle and go to the waste heap or to the manufacturers of certain oleaginous compounds. An endless apron carries the fur forward without disarranging it or changing its natural formation, where it is properly assorted by experienced operators.

Each assortment consists of the fur from a particular part of the skin, the chief divisions being the back, the sides, and the belly. Fur cut from the back is the darkest in color; that from the sides is lighter, and somewhat lower in quality. The belly fur is nearly always the lightest in color. It varies in quality, however, being the finest of the principal grades when cut from the beaver, nutria, or muskrat skins, and the lowest when obtained from the skins of land animals, such as the cony and rabbit. Minor assortments consist of the fur cut from the tails of various animals and from the cheeks of the beaver, the latter being the choicest felting fur obtainable. Belly fur is used in making light-colored hats; that from other portions is available for the production of felt hats of every desirable color. All of these assorted furs are placed separately in paper bags, containing 5 pounds each in America and England and 1½ kilogrammes each in France, in which they are stored or marketed.

The blown furs are those obtained from fur-cutters' waste, which every furrier establishment saves carefully. These pieces are assorted and sold to the cutters of hatters' furs at prices ranging from \$1.25 per pound for beaver to 15 cents per pound for mink clippings. The fur-cutter runs them through a chopping machine, where they are cut into minute pieces, and afterward are repeatedly blown to separate the fur from the overhairs and pieces of skin. Blown fur is not usually carotated, and since it is short and is not readily assorted into various grades it sells for considerably less than cut fur.

NORWEGIAN COD LIVER OIL.

PURE cod liver oil has for some time been a scarce article in the world's markets, owing largely to the many admixtures and adulterations used by unscrupulous and careless manufacturers. The best Norwegian oil is extracted from the fat livers of the cod in the early part of the winter fisheries in the Lofoten Islands. The livers at this time, in January, February, and a part of March, are as a rule light colored, plump and very rich in oil, which is extracted after careful sorting of the livers, with simple machinery, by steam. The product is as clear as crystal, nearly tasteless, and without smell. The islands present many advantages over other places for the production of strictly pure oil. The shoals of fish seek the shore for spawning purposes and the banks are so near land that the boats sometimes land two catches in one day, consequently the livers are, except when stormy weather interferes, received fresh at the factories daily. The United States Consul at Christiania says that the average annual catch of cod in the islands is 30,000,000. Unlike other districts in the country, the cod at this time of the year is about the only kind of fish caught, so there is less opportunity for mixing the livers from cod with those from inferior fish, such as pollock, ling, haddock, tusk, and others. Oil from these contains less fat, the color of the oil is darker, and its medicinal properties are of less value. Oil from these and other inferior fish may be bleached by exposure to the sun in glass coverings, and by various chemical processes. Experiments have been made in Norway for manufacturing cod liver oil on board ships located among the fishing fleet in the open sea, but it has been found that the ship's motion had a detrimental effect on the oil thus produced. Establishments on shore in places where unmixed cods' livers can be obtained fresh every day, are found to be the best. The livers have to be carefully cleaned, and only those of the right color selected for medicinal oil. The year 1903 was an exceptional one as regards the Norwegian winter cod fisheries. In ordinary years, the shoals of fish arrive in the beginning of January, but last year no fish whatever appeared before the middle of March, and they were then found to be in such poor condition that only a very insignificant quantity of oil was provided—only 3,000 barrels against 30,000 barrels in ordinary years. The quality of the 1903 output was also, as a rule, poor. It is estimated that in ordinary years the livers of 4,500 cod are required to produce a barrel of 30 gallons of medicinal oil, while 40,000 livers were required in 1903 to produce the same quantity. Cod liver oil can be properly tested as to purity by chemical analysis only. Where large quantities of oil of inferior grade are added, it can be detected by experienced people without any scientific test simply by the difference in taste and color. Fears have been expressed that the conditions ruling the Lofoten fisheries in 1903 will also make themselves felt in 1904. According to recent reports the Greenland seal has again

* Extracted from U. S. Fish Commission Report 1902.