one of English, and electives, and the requirements for admission to advanced standing were further advanced. Again, the tuition fee was raised to one hundred and fifty dollars from a fee ranging from one hundred to one hundred and forty dollars. This increased tuition fee affected all entering students either for the first year class or for advanced standing. Under this new requirement the registration for the entering class dropped to 5 and the number received to advanced standing dropped to 8, although 69 applied for advanced standing and a very great number for admission to the first-year class. As a result of the changes in the medical school, the registration dropped in three years from 185 to 68, and the number will probably decrease next year, as the last of the larger entering classes on the old basis will pass out. The registration of the college, where the admission requirements have remained the same, shows a fair increase.

Western Reserve.—In 1911–12 the law school became, as the medical school has been for some years past, a graduate school.

Wisconsin.—Of the 802 students in agriculture, 50 are graduate students, and of the 728 in the engineering school, 20 are graduate students. The figures for pharmacy are inclusive of 26 students enrolled in the two-year pharmacy course, which does not require four years of high school preparation. The 5 students listed under "other courses" are enrolled in the Wisconsin library school, and are also counted in letters and science. In addition there are 31 students enrolled in the library course, which does not require four years of high school preparation. The figures are also inclusive of the students enrolled in the short courses in agriculture and in dairying. Last year there were 424 in the former and 133 in the latter.

Yale.—The decrease in the enrollment in the law and medical departments is due to the continued application of the recently increased requirements for admittance to these departments. The present general requirement for admission to the Yale law school is a bachelor's degree from a college of approved standing. The general requirement for admission to the medical school is a college degree or evidence of completion of at least two years of regular college work. The registration in the first year classes of the law school and medical school is greater than the final registration in the first-year classes of these schools for last year.

Rudolf Tombo, Jr.

THE FUR SEAL CENSUS

Ever since the fur seal herd of the Pribilof Islands came into the possession of the United States, through the purchase of Alaska, in 1867, one of the most important practical problems in connection with its management has been the making of some sort of enumeration or estimate of its numbers. The first attempt was made in 1869 by Captain Charles Bryant, first agent in charge of the herd. He estimated that the animals occupied 18 miles of shoreline to an average depth of 15 rods, 20 seals to the square rod, giving a total of 3,265,000 breeding seals and young. He did not estimate the number of non-breeding seals, animals of three years or under of both sexes.

A second attempt was made in 1872–74 by Mr. Henry W. Elliott, a special agent of the Treasury Department. He followed the same method of gross estimate, refining somewhat upon Captain Bryant's work, as it were, reducing to feet and inches what his predecessor had expressed roughly in miles and rods. His breeding area differed radically from that of Captain Bryant—6,386,000 square feet instead of 23,500,000. He, however, assigned only 2 square feet to each individual animal, whereas Captain Bryant gave 14 square feet. These over- and underestimates practically balance each other and leave

the results about the same. Mr. Elliot found a total of 3,193,000 breeding seals and young, 72,000 less than Captain Bryant. He estimated the non-breeding seals also, finding a number sufficient to bring the grand total for the herd up to 4,700,000 animals of all classes.

In 1890 Mr. Elliott duplicated his census of 1872–74. It was a greatly reduced herd he found at that date. The breeding area he estimated at 1,900,000 square feet, and applying to this the same space unit, found 950,000 breeding seals and young.

The next serious attempt to estimate the herd was made in 1895 by Mr. Frederick W. True, of the Smithsonian Institution, and Mr. Charles H. Townsend, then connected with the United States Bureau of Fisheries. The herd had suffered still further decline through the ravages of pelagic sealing, an indiscriminate form of hunting in the open sea particularly destructive to the breeding females. Messrs. True and Townsend were able to count the individual animals on certain breeding areas, 7,479 in all. From charts of the rookeries, on which the areas had been traced at the height of the season, the extent of the counted area was obtained and hence an individual unit of space. Each animal was found to occupy a space of 46 square feet on scattered breeding grounds and half this space on massed grounds. Completing the measure of breeding space for all the rookeries, from the charts, and applying to it the units of space, a total of 131,833 breeding seals and young was found, with non-breeding seals enough to bring the total for all classes up to 155,977.

Coincident with the above estimate was one made by Colonel Joseph Murray, a government agent on the islands. He estimated and counted the breeding families, 5,000, and assigned arbitrarily an average of 40 cows to each, thus reaching a total of 405,000 breeding seals and young.

In 1896 a new investigation of the fur seal herd was begun by a commission under the leadership of President Jordan, of Stanford University. Both the above estimates were before this commission. The method of obtaining the unit of space used by Messrs. True and Townsend commended itself as worthy of imitation, but on test the rookery charts were found unreliable and a new basis of estimate was sought. The areas on which individual cows had been counted in 1895 were recounted, and enough additional space to bring the total up to 16,679 individual cows, in 1,245 families, an average of 13 cows to a harem. A complete count of harems was then made with the intention of applying the average to it after the manner of Colonel Murray.

While this census of 1896 was in progress, however, it was discovered that there were more pups on the counted areas than the number of cows previously counted warranted, and a full count of pups showed them to outnumber the cows two to one. In all previous estimates it had been assumed that at the period of development in rookery population known as the height of the season all or practically all the cows were present. The count of pups proved this to be an erroneous assumption, that in fact when most of the cows were present half at least of them were at sea feeding. The average harem obtained from the count of cows was therefore abandoned and one obtained from the count of pups substituted. This gave a total of 157,405 cows, with a like number of pups, in 4,932 harems, or a total of 319,742 breeding seals and young. The estimate for non-breeding seals in 1896 brought the total for all classes up to 450,000 animals.

In 1909 the writer duplicated this census of 1896, finding 50,626 cows in 1,387 harems, or, adding a like number of pups, a total of 102,639 breeding seals and young, with non-breeding seals sufficient to bring the total for the herd up to 158,520 animals.

The method of enumeration thus established in 1896 has been continued each season since with slight variation. The method of estimate was not held to be exact. It was recognized that exact results could only be obtained by a full count of pups and this was considered in 1896 to be physically impossible. The chief importance of the enumeration,

however, lay in its value as a measure of decline, and for this purpose the results were as satisfactory as a complete count would have been.

By the treaty of July 7, 1911, the United States secured, through the cooperation of Great Britain, Russia and Japan, the abolition of pelagic sealing. The herd was thus freed from the drain upon its breeding stock and hope for its restoration was revived. The season of 1912 was the first under the new treaty. It became important therefore to know the exact status of the herd and a full count of the pups was undertaken and successfully accomplished by the writer. The rookeries of St. Paul Island gave 70,035; those of St. George Island, 11,949—a total of 81,984 pups. As each pup accounts for a mother seal, there was a like number of breeding cows. The harems numbered 1,358, an average of 60 cows to each, giving a total of 165,325 breeding seals and young, with non-breeding seals estimated at 50,412, or 215,738 animals of all classes.

Omitting the non-breeding seals, which can only be estimated, and dealing only with the breeding seals, we find an excess of 62,685 animals over the estimate of 1909. Approximately 15,000 cows reached the rookeries in 1912 and brought forth their young, which under pelagic sealing would have been killed at sea. These with a like number of pups swelled the herd and account for 30,000 of the excess. The remaining 32,685, made up of cows and pups, are accounted for by underestimates in 1909, from applying to large rookeries averages obtained from smaller rookeries. The average harem for all the rookeries in 1912 is 60 cows; that used in making the census of 1909 was 36. If we deduct the 15,000 cows saved through cessation of pelagic sealing, the average harem for 1912 drops to 48. Applying the difference between this and 36 as a correction to the census of 1909 would add to it 16,644 cows and an equal number of pups, 33,288 in all, a figure sufficiently near to 32,685 to show that it is fairly accurate. As a matter of fact the herd has not changed much since 1909. The pelagic catch has merely taken, in the past three seasons, a number equal to the annual increment of gain, that is, the excess of young breeding cows over the natural loss in adults due to old age. By this normal increment of gain, which is about ten per cent. yearly, now protected from loss, will the herd rise to its former populous condition.

The counting of the fur seal herd is a simple but at the same time laborious process. The animals occupy six to eight miles of shore front, in a belt, varying in width with the character of the ground, but never more than 150 to 200 feet, often much less. The work must be done in the first week or ten days of August, between the close of the breeding season and the time when the pups become accustomed to the water. The adult animals are driven off by native helpers. The person counting and his assistant cut off a pod or group of pups, numbering 50 to 100, at a rookery end, forcing it along the beach for a distance of one or two hundred feet. The animals string out in a line, the older and stronger forging ahead, and the counting is done by twos and in groups of threes and fours while they are scattered. It is like counting sheep as they pass through a gate. A second pod is cut off and treated in the same way, and so throughout the length of the rookery. In the end the entire rookery population has merely been shifted along the beach a short distance, the adult animals return and conditions are soon readjusted. At certain places close search must be made for animals asleep or hiding in the crevices of the rocks. Through failure to get all of these at times the counts are slightly under the exact facts. Count must also be made of the dead, of which a number—1,060 for all the rookeries—were found, such deaths being incident to exigencies of rookery life. The counting of the 82,000 pups occupied eight days, the largest single day's work being 20,000.

The process sounds simpler than it really is. The adult animals are always more or less dangerous. The pups themselves have anything but gentle dispositions and their teeth are sharp enough to penetrate rubber boots.

The ground also presents difficulties. Long stretches of unstable bowlders are interspersed with jagged lava potholes. There are cinder slopes and basaltic benches. In places the rocks are worn smooth as glass by the friction of innumerable seal bodies and the bowlders near the water line are always treacherous with slime and slippery sea growths. Over all is the unspeakable Bering Sea weather—without sunshine and alternating between thick and thin fog accompanied by rain, flying spray and howling wind.

The result, however, repaid the effort. For the first time the breeding stock of the herd has been brought within the range of exact figures. The herd is shown to be in better condition than was expected. Its recuperation will be more rapid. The splendid body of pups disproves absolutely the contention which has recently played so important a part in discussions of the herd's condition, namely, that the stock of breeding males has been reduced too low or become invirile and impotent through the operations of land killing. The immediate response of the herd to its release from the drain of pelagic sealing as certainly proves this to have been its sole cause of decline.

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August 31, 1912

THE FUR SEAL MORTALITY OF THE PRIBILOF ROOKERIES IN THE ABSENCE OF PELAGIC SEALING[1]

THE breeding season of 1912 for the Pribilof fur seal was the first in many years unaffected by pelagic sealing. The herd has promptly responded to the removal of this determining check to its increase. The deaths on the rookeries reflected not only the arrest of pelagic sealing but the drop in the rate of natural mortality which has been much more rapid than the rate of decrease of the herd. The question of mortality was investigated in 1896 and 1897 by the Fur Seal Commission, and during the past season by the writer, the death of the young being the chief concern in both cases. The loss during the entire season, until the migration of the cows and pups late in the fall, has never been covered, but the major portion occurs earlier and indicates the proportions of the mortality from natural causes. In 1896 and 1897, putting aside the heavy loss from pelagic sealing by using only the data prior to August 15, the approximate date on which starvation caused by the pelagic catch began to be fatal to the young on the rookeries, the two chief causes of mortality of pups were uncinariasis (hookworm disease) and natural starvation, the former leading and placing a heavy incubus on the herd. The seal mother bears a single pup each year, and will nurse no other than her own offspring. Pelagic sealing therefore caused the starvation of the young by an artificial interference with the herd, while natural starvation is due to accidental deaths of females which have nursing pups and probably also to their failure to find their offspring after returning from trips to sea. It was estimated at 30.8 per thousand in 1896. The total loss from all causes in 1896 before the middle of August was about 90 per thousand.

The data obtained in 1912 make necessary some readjustment. The total natural loss to August 22 on St. Paul Island is 880, or 12.5 per thousand. From starvation to the middle of August a death rate of 4.3 per thousand is indicated, and from uncinariasis for the whole season a rate of much below 1 per thousand. Uncinariasis has thus become a minor and insignificant cause of loss, ranking not nigher than fourth, a result which must be due solely to the thinning out of the herd, for no artificial measures against *Uncinaria* have been applied. The worm could not be found on Polovina, Gorbatch and the Northeast Point rookeries, all formerly well infested. The old rookery strongholds for this disease in the sands of Zapadni, Reef and especially Tolstoi, are alone now occupied and they yielded only 17 uncinariated pups, 5 of which were associated with starvation, out of a total of 175 examined. By making these sandy

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