the pulley at the start, the weight will reach the pulley while the monkey is still five feet from it. If both parties are ten feet from the pulley at the start, the monkey, when he reaches the pulley, will have passed twenty feet of rope through his hands, under a tension of ten pounds. That is, he will have expended twice the energy that would have been required, if the weight had been held motionless. As regards the influence of the inertia of the moving body (touched upon at the end of the article) it is evident that the energy expended at the beginning of the ascent to acquire velocity will be restored at the end of the trip as the velocity is gradually reduced to zero.

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THIS problem to which Dr. Hering has called attention in SCIENCE, February 15, was invented by Lewis Carroll (C. L. Dodgson) in 1893. In the *American Mathematical Monthly,* volume 28, 1921, pp. 399–402, may be found a history of the problem, and solutions by Professors E. V. Huntington, of Harvard University, and L. M. Hoskins, of Stanford University. Neglecting also the weight of the pulley, the monkey and weight will move upwards at the same rate.

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SCIENTIFIC BOOKS

The Conservation of Wild Life in Canada. By DR. C. GORDON HEWITT, Dominion Entomologist and Consulting Zoologist. Charles Scribner's Sons, New York, pp. 1–344, 1921.

THE late Dr. C. Gordon Hewitt's volume on Canadian wild life gives us for the first time a thoroughly comprehensive account of the larger mammals and birds of Canada from the conservation point of view. A distinctive feature of the book is its clear recognition of the fact that in Canada the wild life problem is, economically considered, largely a question of the proper utilization of the non-agricultural forest lands. He says:

> Not all lands are suitable for agriculture. Even in the best agricultural sections of the country areas unsuited to agriculture occur. In some cases, as will be shown later, such areas have been set apart as forest reserves; in other cases a struggling population endeavors to eke out a meager existence on the sparse products of the unfertile soil. The problem of the best method of dealing with such non-agricultural lands has already received some consideration by our governments. In the future it will demand more attention than we have hitherto thought necessary. And it is here primarily that the practical application of the principles of wild-life conservation should receive serious attention, for it will afford one of the most important methods by which the unproductive or scarcely productive areas can be rendered productive.

Northern Canada is so barren, in spite of Stefánsson to the contrary, that only detailed and extensive investigations will provide plans for a proper use of its resources. Dr. Hewitt remarks:

> The economic development of northern Canada is dependent upon the proper conservation of the wild life of that section of the Dominion. If adequate measures are adopted to conserve upon proper lines the game and fur-bearing animals of those portions of the Northwest Territories unsuited to agriculture, and such portions constitute by far the greater part, there is no reason why the whole of that area should not be productive and contribute to the wealth of the country. The possession of such territories would become a matter of pride rather than of reproach. . . . This country contains the greatest variety of valuable fur-bearing animals, for the possession of which men risked everything, including their own lives. Now our agricultural lands constitute that lure, but the remnant of those fur-bearing animals is still with us. Conservation of our natural resources is taking the place of exploitation. We should apply the doctrine to the fur-bearing animals and thus secure their full value to the community. And it can not be stated too often that conservation means the protection of natural resources from injudicious exploitation and their provident utilization. Our northern territories, under proper administration, could become not only a valuable source of food supply, but also one of the chief fur-producing areas of the world.

The chapter devoted to the enemies of wild life and the method of controlling predatory animals contains much interesting data on Canadian conditions and gives considerable additional evidence of the failure of the bounty system as a satisfactory method of controlling these animals. Hewitt states:

> And while the complete extermination of such predatory species is not possible, desirable, or necessary, a degree of control must be exercised to prevent such an increase in numbers as would affect the abundance of the non-predatory species.

One of the most valuable parts of the book is the chapter on the periodic fluctuation in the number of fur-bearing animals. He furnishes graphs showing the fur returns of the Hudson's Bay Company from 1821 to 1914 and thus summarizes his conclusions:

> First, the herbivorous rodents such as mice and rabbits, which are very prolific and increase in numbers until they reach an abundance which causes overcrowding, when an epidemic of disease almost wipes them out and their numbers rapidly decrease to a minimum. Second, we have the numerous predatory animals which depend for their subsistence either directly or indirectly upon the mice and rabbits. These animals exhibit fairly regular periodic fluctuations in numbers, their abundance being

correlated with the abundance of the animals upon which they feed, although, as we pointed out in the case of the fisher, there may be a distinct periodic fluctuation which does not appear to be directly related to the fluctuation in the numbers of any particular food animal. Finally, we have the animals that feed on a mixed or exclusive diet of insects, vegetable products, fish, or miscellaneous diet, that do not show any marked periodic fluctuations. (P. 232.)

These periodic phenomena should be carefully compared with other periodic activities, such as that of rainfall, sun spots and periodic tree growth, as investigated by Huntington and Douglass.

Just as in the United States the management of fish and game has been largely in the hands of the states, so in Canada it has been largely in the hands of the provinces. But in the unorganized Northwest Territories and the Yukon Territory the Dominion government controls, as also in the case of the treaty with the United States with regard to migratory birds, in the execution of which Hewitt played an important rôle. At his suggestion the Northwest Game Act has been changed to give adequate protection for the fur-bearing animals, by a license system, and to give as well better protection to the musk ox and the barren-ground caribou. Hewitt points out that the fur trade was the primary industry of the region, and that unless properly maintained this enormous area of the Dominion would become incapable of supporting a population, and that its natives would starve or become a burden on the government. He also points out that the Danish government maintains a monopoly of the fur trade in Greenland, and in this manner controls trapping in such a way as to conserve the breeding stock. By applying this method of a "sustained yield" to fur, to borrow a forester's term, a stabilized and permanent industry would be guaranteed. On account of the paramount interest of the Dominion government in the native population, Dr. Hewitt suggests:

A careful consideration of the problem of our northern fur resources and the position of the native population in relation to the exploitation of such resources serves to impress one with the fact that the taking over and administration by the Dominion Government of the fur trade of the Northwest Territories would be most desirable from all points of view. The following proposal is therefore made. The Dominion Government should take over the entire control and exploitation of the fur trade and wild life resources of the Northwest Territories by enacting the necessary legislation. This would involve the purchase of such rights as the Hudson's Bay Company have in the Northwest Territories. In order to administer the monopoly it would be necessary to establish certain government posts such as those now maintained by the Hudson's Bay Company. This would be a great advantage in securing proper and adequate government administration in the Northwest Territories, where the need of government agents to take charge of the affairs of the Indians, the enforcement of the law, the collection of customs, and oversight of other government activities in these territories is becoming increasingly felt, and will undoubtedly become greater with their development. . . .

If such a policy were adopted it would accomplish the following ends. A source of revenue would be created of no small value, even after the expenses of administration were paid, and it is proper that the profits accruing from the exploitation of the fur resources of these territories should go into the national exchequer. It would be the most effective method of conserving the fur resources and wild life of the Northwest Territories, as the enforcement of the law and the adoption of any necessary restrictive measures could be directly supervised. It would afford a means of attending to the requirements of the natives who stand in need of more immediate supervision, which is difficult to give at the present time. The natives, both Indian and Eskimo, would be protected to a greater degree than at present from the influence and exploitation of unscrupulous traders, which would be an advantage from the standpoint of morals and health.

The nationalization of such natural resources as forests has proved in Europe to be the most successful means of conserving such resources, and at the same time this policy has furnished a valuable source of national revenue. There is no good reason why such a policy should not be adopted in the case of our northern fur resources. The thoughtful consideration of this purpose is therefore respectfully urged. (Pp. 261–262.)

There is still another important Dominion control exerted over wild life, and that is in the Canadian National Parks. One of the main aims for these parks is for our own generation to pass on to the future the wild life of these regions. The intelligent formulation of satisfactory rules for the protection of wild life and their enforcement, is a subject that should receive the most careful attention of Canadian naturalists, until the Canadian Parks are properly staffed with scientific men, clothed with authority as well as with responsibility. Naturalists are only beginning to awaken to the importance and seriousness of this matter. There is an urgent, acute need for careful, scientific study of the predatory animals in these parks (and elsewhere for that matter), because of the prevalence of a strong prejudice against the predatory animal. A sane, long look ahead is what is needed in this matter. It is only too easy to order out the trapper or hunter to kill these animals, without a previous and adequate study of the whole situation. The eagerness with which the uninformed public devours news items concerning the destruction of supposedly dangerous animals readily makes fuel for cheap politicians.

The general public will probably not miss the absence of a bibliography such as the author must have acquired during the preparation of the volume,

but it would have added considerably to the value of the book for those who are unfamiliar with the local sources of information. One also regrets that Labrador and Newfoundland were not included within its field, because our American public needs guidance there as well as elsewhere in British America.

Considering the book as a whole, it must be considered a very valuable summary and contribution to the literature on American wild life conservation. The sane and judicial method of presentation carries with it a confidence that will do much for the cause. We regret the loss of such an able leader as Dr. Hewitt and hope that a new one will be found to continue this excellent work.

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LABORATORY APPARATUS AND METHODS

THE LABORATORY AND DEMONSTRATION PROBLEM OF MODERN PHYSICS

SOME of the more recently developed fields of physics, constituting what some writers call "modern physics," appear to offer some problems relative to laboratory practice more or less peculiar to the subject-matter involved and distinct from those of general courses. Certainly, the content and methods of these courses show far greater variation among the universities than the older courses which have become more or less standardized. In view of this it appeared worth while to ascertain by means of a questionnaire sent out to a number of the larger universities just what is the trend of present practices along this line. Information from about twenty-five laboratories was thus secured, and last year the material thus obtained was supplemented by personal visits to a few laboratories and through contact with physicists at meetings.

It would appear that, so far as lecture work along these lines is concerned, practically every university is giving definite attention to the newer fields of the subject of physics. A few merely include a number of lectures along such lines in their general courses. Many offer separate courses which often include what might be called the whole field, under some such title as "Modern physics," "Electron theory," etc., and deal with the subject in a very generalized way, but nevertheless in a way designed to meet the needs and interests of the arts students. The larger universities, however, are now offering a number of more or less clearly differentiated courses in this general field, some being offered yearly but many less frequently and depending upon the demand. Such schools usually have one or two courses of the above mentioned general type which are open to the undergraduate student. Their other courses are more or less mathematical in nature and are open to only those advanced undergraduates or graduates specializing in physics. Physics club meetings frequently serve to bridge the gap between these two groups of students and to foster an interest in the present progress of the science. In the general modern physics course for undergraduates the enrollment is usually good, one university reporting a class of seventy, but the number enrolling in the advanced courses is, as might be expected, usually small.

The laboratory practice, however, in connection with such courses is far less uniform, both in respect to what is actually done, and what those offering the courses think should be done. Of the schools reporting courses along these lines slightly more than half reported laboratory work as a part of the course, and the time given to this work is usually one afternoon a week. In one case four or five laboratory experiments were given, but no regular laboratory period was scheduled. In a number of schools a few experiments along the lines here discussed are worked into other courses. In schools offering no individual work, a number of lecture demonstration experiments are given.

The nature of the laboratory work varies widely, and in a manner dependent upon the training and dominant interests of the instructor. Experiments intended for undergraduates are somewhat qualitative and no doubt may continue so. For more advanced students the work frequently consists in repeating some of the more classical experiments, or in making observations with apparatus previously assembled by research students. In only a few cases were typed instruction sheets submitted to illustrate the nature of the work done; generally it was indicated that the work was as yet merely in the formative stage. In spite of this, however, it would appear that, through the personal exchange of ideas and the publication of manuals, experiments along these lines are rapidly working towards something like a uniformity that will make a student's laboratory course in modern physics mean something definite in the way of his training.

The subject-matter of the experiments reported would indicate that not all the chief phases of the present developments lend themselves easily to laboratory studies by the student, although the gradual elimination of the difficulties must widen the scope of the work attempted. Among the studies attempted, the following partial list will serve to indicate the scope and nature of the work:

"Discharge in air at low pressures," "Variation of force with distance between electrodes," "Study of Braun tube (in modified form)," "Cathode rays (including e/m determinations)," "Canal rays and Dop-