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THE ANATOMY OF THE ORANG-OUTANG. BY A. PRIMROSE, M.B., EDIN.

(Read December 18, 1897.)

A good specimen of the animal was obtained in the Anatomical Department of the University of Toronto during the autumn of 1897. This animal, which is the chief representative of the Anthropoid Apes in Asia, is found in the islands of Borneo and Sumatra. A series of photographs were made of the creature, and by this means the external characteristics were readily studied. The shape of the cranium is very similar to the human type, but the facial region of the skull projects very prominently, so as to produce a markedly diminished facial angle. Thus the photograph taken in profile shows a projecting muzzle, which is far removed from anything of the kind found in the skull of man. The nose is short and depressed, so that the anterior nares look upwards and forwards. The forehead is high and fairly prominent, in this respect differing from the condition found in the Chimpanzee, in which the forehead is retreating; in the Orang, in fact, there are frontal eminences to some extent developed. The eyelids are wrinkled, so that a series of grooves parallel to the free margin exist in both the upper and the lower eyelid. The eyes are never widely open in the Orang. From the margin of the lid project well developed eyelashes. The lips are very wide, and possess a great degree of mobility: the degree of mobility may be appreciated even in the dead animal when one separates the lips and exposes the jaw arches. The dental formula is similar to that of man—in this specimen a noticeable feature was the width and flatness of the central incisors. There is no prominence in the region of the chin. There is a very gradual curve extending from the free margin of the lower lip and merging below into the outline of the neck. The ear of the Orang and the Chimpanzee is said to be curiously like man; this statement is borne out in the present instance. The ear stands out fairly prominently from the side of the head, but not more so than in many men. Along the edge of the infolded margin of the ear, near its upper part, there exists in man a blunt-pointed process, to which Darwin has called attention, and which is supposed to represent that part of the ear which exists in many monkeys as an upper pointed extremity without any infolding. We find that a well marked process representing Darwin's point is present in this Orang. There is no lobule; it is entirely absent. In man the lobule is very frequently absent also. The Orang possesses a short, thick neck, of great strength. Lastly, in connection with the head of this animal one must note the absence of any wrinkles in the forehead. In man the wrinkling of the forehead forms one of the most characteristic forms of expression, but we find no trace of such in this Orang. The fact that this form of expression is not possessed by the Orang has been noticed by various observers.

The long arms of the Orang, reaching below the knees, and the comparatively short lower extremities, are noticeable features of the animal. In this respect it differs from man, in whom the lower extremities exceed the upper extremities in length and are much more strongly developed, thus serving more efficiently as a basis of support in the erect attitude. It must be remarked, however, that this remarkable elongation of the upper extremities in apes is also reproduced in many negroes, and occasionally in Europeans.

In an address delivered at the recent meeting of the Anthropological Section of the British Association, in Toronto, Sir William Turner selected as his subject "Some Distinctive Characters of Human Structure." Among other things he

referred to the markings which are found in the integument in the palm of the hand and the sole of the foot. I have made photographs of the palm and the sole in the Orang, and these well illustrate the conditions found as described by Prof. Turner in the Anthropoid Apes. The two oblique lines which run from the base of the index finger to the inner side of the palm in the human hand indicate the lines along which the fingers are bent in towards the palm. The obliquity of these lines in man is in contrast to the transverse direction of the lines as shown in the photographs of the Orang. It is quite obvious that the oblique direction in man indicates that the fingers are more directly opposed to the thumb in man than is the case in the Ape. Thus, in the Orang, the fingers are folded more directly into the palm, as would be the case if the animal were grasping a cylindrical object, hence transverse lines result and the fingers are not to any appreciable extent opposed to the thumb, which, by the way, is a very rudimentary structure in the anthropoid apes as compared with the thumb of man. This rudimentary thumb in the Orang, is, however, capable of opposition, and therefore we find that the deep groove which is found separating the eminence at the root of the thumb in man is also found in the Orang. In the Orang we find, too, that there is a well marked groove marking off an eminence at the root of the little finger. When we come to examine the sole of the foot in the Orang we find here a very characteristic condition. A well-marked line is developed at the root of the great toe, indicating the line along which the great toe is opposed to the other toes. This is a characteristic not possessed by man, in whom the great toe is not capable of opposition and in whom this mark is entirely absent. Further, the lines at the roots of the toes are in reality more oblique in the foot of the Orang than in the hand of the same animal. This would indicate that the foot is better adapted for grasping objects than the hand, and that opposition of the smaller toes to the great toe is more perfect than is the similar movement of opposition in the hand. In the foot of the Orang, further is to be noted the great length of the toes, producing a marked resemblance to a hand. The great toe is very much shorter than the remaining digits, but it is strongly developed otherwise and is much more effective as a grasping agent than the corresponding digit in the hand. This foot of the Ape so much resembles a hand that it has been called a foot-hand; the term "pedimanous" has been used to describe the condition. When we come to examine the structure of the foot, however, and study the bones, muscles, ligaments, etc., we find that, morphologically, we are dealing with a foot, and from that standpoint it is in no sense a hand. Physiologically, however, it performs the functions of a hand as well as of a foot. Turner alludes to an interesting point regarding the development of the markings on the palm, namely, that they are found in the human embryo at a very early stage of development, long before they could be accounted for by movements occurring in the hand of the embryo. This would indicate that the markings themselves were hereditary and are not simply acquired after the various movements which they indicate are brought about.

The Orang possesses a highly developed brain. In the particular animal we are describing the brain was removed and examined. The antero-posterior diameter of the brain is less in proportion to the transverse diameter than it is in man. The brain of the Orang may be described as a round-oval. The characteristic fissures and convolutions of the human brain are readily distinguished in the Orang. The external occipital fissure is much longer than in man. This is so characteristic of the brain of apes that it is known as the "Simian Fissure." The Island of Reil is completely overlapped in the Orang by an operculum. The third frontal convolution—said to be characteristic of man—is certainly not well defined in the example before us. This convolution of the left side in man is the so-called "speech centre." The convolutions about the fissure of Rolando—the Motor Area—are well developed.

The abdominal viscera were examined and one noted the existence of a long, well developed vermiform appendix. This structure is present in the Orang and the Chimpanzee among Anthropoid Apes, but is generally absent in Monkeys and in the majority of Mammals. One noted also the entire absence of those reduplications of the mucous membrane of the small intestine which are described in man as the "Valvulae Conniventes."

The author of this paper proposes to make a complete dissection of the Orang, and hopes to make a further communication to the Institute when the work is complete.

THE TRANSPORTATION QUESTION. BY J. S. WILLISON, ESQ.

(Read April 16, 1898)

I.

A discussion of the transportation problem in the language of hysterical Populism unfits the public mind for a sane judgment and drives Legislatures and Parliaments to attempt legislation so rash, extreme and impracticable that rational reform is embarrassed, disastrous reaction invited and the public authority discredited. Too often that class of vociferous patriots who move against the railway corporations with a fleet of froth and an army of adjectives accomplish no other result than to inflame the public temper, disturb legitimate private investments and hurt the national credit. Always in the field of economics the forces of order are "turning to scorn with lips divine the falsehood of extremes." Indiscriminate denunciation is the vice of the press and the pastime of democracies. We in Canada, in recent days, have had much hearty denunciation of railway monopoly, and corporation-baiting threatens to become the chief business of some of our influential journals and of an active and aggressive wing of our politicians. It is beyond doubt that we have made grave mistakes in railway policy. We have been cheated by the phantom of railway competition. We have unwisely duplicated pioneer lines. We have rashly vested great tracts of the public heritage in railway corporations. But we are a young community, at least in range of settlement and in measure of development, and we have had great problems to solve; and it was perhaps inevitable that just as we gave noble forests of timber to the fire in clearing the virgin lands of older Canada, so we should make a prodigal use of the resources of the west in laying the lines of rail communication across the continent. Now, as to these grave follies of statesmanship and grave errors of policy, we can perhaps do nothing better than to say with Bacon: "That which is past is gone and irrevocable, and wise men have enough to do with things present and to come; therefore they do but trifle with themselves that labor in past matters."

II.

We should remember, too, that railway transportation has not been a profitable business in Canada, that millions of English capital have been sunk irretrievably in the Grand Trunk, that with the slow growth of settlement in the west only exceptional resource and exceptional enterprise could have maintained the Canadian Pacific as a going concern, and that both of our great through roads have been heavily burdened with unprofitable branches. Canada's reputation in the money markets of the world depends upon a few of its great enterprises. For half a century the spectre of the Grand Trunk has stood at the elbow of the Canadian financier and promoter on the London money market, and all over this country there are idle mines, and untilled acres, and rich fields of natural wealth undeveloped that would have been opened and occupied by the strong arm of British capital if the melancholy story of the Grand Trunk had not been written in financial London. If the Canadian Pacific had met a like fate, a blow would have been dealt us from which we could not have recovered for a generation. We can imagine what a blow would be dealt at the private and public credit of the United States if half the railway system of the Republic were to be plunged into bankruptcy, and when we face the fact that the Canadian Pacific system embraces half the railway

mileage of Canada, it is manifest that the maintenance of its credit is of vital importance to the Canadian people. The improving credit of the Grand Trunk and the established credit of the Canadian Pacific are facts of great consequence to Canada among the nations who supply capital for the development and men for the settlement of new lands; and while we do right to be jealous for the authority of this free community over its carrying corporations, we should be slow to work ourselves into the passionate temper of western Populism, and thereby check the movement of capital from the uneasy centres of the United States into the undeveloped Canadian Provinces. Capital is mobile. It will not rest where it is constantly menaced by political agitation. It will not seek investment where political conditions are unstable, and established enterprises harassed by revolutionary political experiments. The best service we can do for Canada is to introduce into our public controversies and to incorporate into our code of laws the prudence, the sanity, the steadiness of the British political temper and the sober courage and inflexible justice of British legislation.

III

One lesson that a democracy finds hard to learn is that legislation cannot be made omnipotent. In Great Britain, more than in any other country, the practical limitations of Parliamentary authority are understood and appreciated. There, after fruitful centuries of trial and experiment in all the fields of coercive legislation, from statutes fixing the wages of laborers and the prices of goods at wholesale and retail, to statutes declaring the value of money and restraining the freedom of trade, private employments are at length safe from the British legislator, while over public employments the authority of Parliament is absolute and unquestioned. Railways operate in the field of public employments, exercise rights of expropriation and hold public franchises, and therefore the inferiority of the carrying corporations to the sovereign authority of Parliament is established and the right of regulation and control freely asserted. In truth, the authority of the people over transportation agencies is well settled in all free countries, and argument upon that point may rest. Having settled that these powers are vested in Parliament, the question is, through what machinery they can best be exercised. The Railway Committee of the Privy Council at Ottawa has large powers, but these have been but feebly employed for the protection of the public interest, and the technical defences of skilled counsel and the active zeal of equally skilled lobbyists make its procedure tedious and complicate its judgments with political considerations. Then the dealer, who may be prejudiced by discriminatory favors to a competitor; the farmer, whose safety may be imperilled by a dangerous crossing; the town or village, whose progress may be checked by the concession of lower freight charges to a rival community; the carrier that may be refused reasonable interchange of traffic by a competitor—each and all of these have found the Railway Committee inadequate to give satisfactory redress. The individual citizen, aggrieved by railway greed or vindictive discrimination, cannot go to the capital and lay his grievance before the committee. The cost is too great, the undertaking too onerous. He requires the privilege of communicating his complaint to a public commissioner, and upon the commissioner should rest the responsibility of investigating the complaint and redressing the injustice. The commission must operate through methods of conciliation as well as through methods of compulsion. There is no doubt that in many cases the American Advisory commissions, that is, the commissions with power only to report the facts and leave to public opinion, either acting directly on the railway corporations or through the Legislature, the remedy for the evils established, have been influential in redressing the more flagrant discriminations and injustices of railway managers, and in Massachusetts, for example, it has not been thought necessary to adopt more drastic legislation. But at most the power

of the advisory commissions is no greater than the force of public opinion and public opinion is likely to be inactive, except during seasons when the transportation question is a main issue in the press or in politics, or some very special grievance looms large in the public eye.

IV.

It is a common notion that in Great Britain the railways are effectually controlled by the Board of Commissioners created in 1873, and vested with the powers of jurisdiction exercised by the Court of Common Pleas under the old law (Act of 1854). Mr. Stickney, in his new book on State Control of Trade and Commerce, declares that this Act is "amply sufficient to redress any substantial injuries done by common carriers to the public," and that in the field of private employments the growth of the law "has been from a condition of minute and annoying restriction to one of complete freedom," while in the case of public carriers it "has been from a condition of comparative freedom to one of complete and adequate supervision and control." This conclusion will not bear investigation. It was the judgment that I had reached from a study of the American books dealing with the railway question, but even a perfunctory and inadequate study of the question on the ground made it plain that the laws regulating common carriers are not as well enforced in Great Britain as in the United States. The great British railway corporations have enormous political and commercial power. There are now 140 railway directors in the Imperial Parliament. The British railways support the Parliamentary bar, they control influential organs of financial opinion, they keep a strong hand upon the course of legislation, and they discriminate against the domestic in favor of the foreign shipper to a degree that is intolerable. It seems to be the fact that grain and other food products are carried from Calcutta or from New York to London for rates much lower than are charged on similar home products from mid-England into the metropolis. The British agriculturist suffers almost as seriously from railway discrimination as from hereditary landlordism, and German and Belgian and American competition with British manufacturers is greatly aggravated and materially promoted by the secret discriminations and lower rates made for foreign competitors with British industries.

V.

There is combination to maintain domestic rates and open or secret competition for the carriage of foreign goods. This, in fact, seems to be a feature of railway administration the world over. The policy of the railway managers everywhere is to enforce the maximum rate on home traffic, and to compete for foreign shipments at any rate that may be necessary to secure the business. The subsidized railways of Canada carry American goods at rates so much lower than the charges exacted upon native products that in many cases the discrimination more than offsets the advantages of the Canadian tariff. No doubt the result of this policy is to increase the bulk earnings of the Canadian roads, and, it may be argued, enables the companies to reduce the average of transportation charges. But the inevitable tendency is to build up foreign rather than Canadian ports and foreign rather than home industries, and to unduly burden local traffic in the interest of through business. As between Germany or Belgium and Great Britain the effect is peculiarly and particularly objectionable. The German and Belgian railroads are owned and operated by the State. There are, therefore, no secret rates or discriminations on the German and Belgian roads, and the embargo which British railways put upon British trade is unknown within Germany and Belgium, and the British manufacturer enjoys no such advantages in the German or Belgian market as the German or Belgian manufacturer and trader enjoy in the market of Great Britain.

But the British people are moving. Some of the younger British politicians have been making a close study of the State railways of the continent; there is unrest among the agricultural population, and manufacturers are awakening to the injustice of these intolerable discriminations in favor of their foreign competitors. And once the British people are thoroughly roused to the existence of an injustice, reform comes speedily and thoroughly. It may be that for the moment the British people would not consider State ownership, but we must remember that they have taken over the telegraph service, that that service is operated as efficiently as the postal service, and it is at least my conviction that before the world is much older we shall have in Great Britain a formidable movement for State ownership of the carrying corporations, and that public ownership rather than public regulation will be the future railway policy of England. More than half a century ago, as far back as 1844, Mr. Gladstone put through the British Parliament a measure, to take effect 21 years thereafter, declaring the right of the State to take over the railways at such time as the people might determine to be propitious and advantageous, and that the price should be 25 years' purchase of the "annual divisible profits estimated on the average of the three then next preceding years;" and it is a noteworthy fact that, notwithstanding this Act, some of the ablest advocates of State railways in Great Britain counsel delay on the ground that the railway corporations have such vast political power that they would force Parliament to pay for their roads a price far in excess of their actual value.

VI.

Mr. Clement Edwards, in his new work on Railway Nationalization, makes an interesting estimate of the possible financial results of State purchase of the British railways. The profits of the British roads are put at £38,046,065, or 4 per cent. on the capital invested. He believes that the State railway stock would be taken up at 2 1-2 per cent. as a maximum. This would leave a margin of nearly 1 1-2 per cent. on the transaction. He estimates saving by unity of management at £10,000,000. Thus he would increase the profits from £38,000,000 to £48,000,000, and after deducting 2 1-2 per cent., £23,775,000, to cover the interest on the Government railway stock, he would get a net profit to the State of over £24,000,000. He would thus be enabled to reduce freight rates by 20 per cent., absorbing £8,807,000, reduce passenger fares by 20 per cent., absorbing £7,472,000, and use £4,000,000 to reduce hours of labor and improve wages, and still have nearly £4,000,000 to provide for a sinking fund and exceptional contingencies. Mr. Edwards adds: "The recoupment from increased traffic could be used for still further reducing rates and fares, and augmenting the sinking fund to facilitate redemption of purchase, remembering always, however, that the lower the rates and fares are reduced to a certain point, the greater the traffic, and the better for the nation." This is an optimistic calculation, but in sober truth it seems to be warranted by the experience of State operation of railways on the continent.

VII.

A remarkable illustration of the effect of cheap fares on passenger traffic is afforded by the introduction of the zone system in Austria and Hungary. In these countries, under this system, one may travel first-class by fast express at a penny and a third a mile, and third-class at less than a half-penny a mile. In Hungary, for the four years from 1889 to 1892, the number of passengers carried increased from 5,684,845 to 38,325,151, and in Austria, for the six years from 1889 to 1894, the increase in the number of passengers ran up from 42,582,726 to 102,897,828, an increase of 600 per cent. in Hungary and of 140 per cent. in Austria, as compared with 11 per cent. increase in Great Britain. Then, while the Hungarian railways were

paying 3.48 per cent., when the zone system was adopted they paid 6 per cent. in 1892, and while in '89 the Austrian railways paid 4.01 per cent., in '94 they paid 4.08 per cent. It is quite likely that in Great Britain the zone system and cheap fares would yield as good results, and possibly in the United States and Canada the results would be hardly less satisfactory. The main fault to be found with passenger rates on this continent is that they are made to carry a great percentage of deadheads, and of the very class who are best able to travel at their own expense. If this mortuary department were abolished there is little doubt that the Canadian railways could give a two-cent rate without impairment of revenue, even if but a very moderate increase of passenger traffic were secured.

VIII.

The United States has a better railway literature, a greater body of railway legislation, and has made, at least in some of the States, a more determined attempt to regulate and control the carrying corporations than any other country. The results have not been wholly satisfactory. The operation of the laws has been embarrassed by a conflict of jurisdiction, the half-heartedness of Legislatures, and the hostility, or at least the unsympathetic attitude, of the courts. Only such traffic as originates and terminates within a State is subject to the State Commissions, while the authority of the Interstate Commission is limited to interstate traffic. This condition requires concurrent action between the State and Interstate Commissions, creates confusion, gives occasion for technical disputes, necessitates a divided sovereignty, and blocks and complicates the work of the commissions. Still much has been accomplished, particularly by the strong State Commissions, and the work of the Interstate Board has been by no means unfruitful or ineffective. In *The Atlantic Monthly* for April there is an admirable review of the work of the Federal Railway Commission since its creation in 1877. The writer, Mr. H. C. Adams, is the statistician of the Interstate Commerce Board, and ranks high among the authorities on the subject. He tells us that the idea of the commission was that "authoritative principles of railway transportation should be developed very much as legal principles attain their growth," that to this end it was necessary that a large variety of cases of discrimination and unjust rates should be considered, and that in some way this result must be realized if the control of railways through commissions is to prove a permanent part of the political organization, and he argues that "had the courts been willing to grant the commission the interpretation that Congress assured for it when it was passed, the railway problem would by this time have approached more nearly its final solution." Notwithstanding this, however, there has been a marked movement toward uniformity in administration, a useful service of statistics has been developed, and a far step has been taken toward a uniform system of railway accounts. He points out that "if there be but one system of accounts for all corporations subject to the jurisdiction of the commission, it is necessary only to master the principles, rules and classifications of one system in order to gain a mastery of all," and he declares that "out of the opinions expressed upon cases there has begun to develop a system of authoritative rules and established interpretations, which, sooner or later, will come to be recognized as a body of administrative law for inland transportation."

IX.

Mr. Adams gives this compact statement of the main conclusions that have been reached by the commission:

"It has been decided that a just schedule of rates will not tend to destroy the natural advantages for the production and sale of goods possessed by localities;

and when the same commodity is transported by two or more different modes of carriage the charge should be uniform for the unit of commodity.

"'Group rates,' by which a given commodity produced at different points within a prescribed territory is rated as though shipped from a single point, do not constitute a discrimination repugnant to the law; but this opinion is limited to the cases presented and is not set forth as a general principle.

"A rate on one commodity in a class, or on one class of commodities, cannot be justly depressed so as to become a burden on the transportation of other commodities or classes of commodities.

"The law does not impose upon the carrier the duty of providing such a rate that goods may be sold at a profit to their producers.

"The car-load, and not the train-load, is the proper transportation unit, but higher charges may be made for goods in less than car-load lots; with this exception, the decisions of the commission have been consistently against the application of the 'wholesale' principle in the adjustment of railway charges."

"Not only must a just schedule of rates rest on a just base, but the relative rates on competitive articles must be such as not to disturb the natural order of competition.

"A just schedule of rates will conform to the competitive equities that exist between goods shipped at different stages in the process of their manufacture.

"All shippers should have at their disposal equal facilities of transportation; but in judging of local advantages, care must be taken not to confound those that are artificial with those that are natural.

X.

It has to be added that the experience of the United States has established beyond controversy that in order to the successful operation of railway commissions authority must be granted to compel witnesses to testify, that the investigations of a commission must be final on matters of fact, that an order of the commission must be enforced unless the courts shall find some material error in its proceeding and judgment, and that a commission must have the right to prescribe a reasonable rate, as well as to declare that a rate fixed by a carrier is unreasonable. The closing words of Mr. Adams sane and moderate paper are well worth quoting. He says: "The record of the Interstate Commerce Commission during the past ten years, as it bears upon the theory of public control over monopolistic industries through the agency of commissions, cannot be accepted as in any sense final. It may ultimately prove to be the case, as Ulrich declares, that there is no compromise between public ownership and management on the one hand and private ownership and management on the other; but one has no right to quote the ten years' experience of the Interstate Commerce Commission in support of such a declaration. This is true, because the law itself scarcely proceeded beyond the limit of suggesting certain principles and indicating certain processes, and Congress has not, by the amendments passed since 1887, shown much solicitude respecting the efficiency of the Act. It is true, also, because the courts have thought it necessary to deny certain authorities claimed by the commission, and again, Congress has not shown itself jealous for the dignity of the administrative body which it created. And, finally, it is true because the duty of administering the Act was imposed upon the commission without adequate provision in the way of administrative machinery, and ten years is too short a time to create that machinery, when every step is to be contested by all the processes known to corporation lawyers. For the public the case stands where it stood ten years ago. Now, as then, it is necessary to decide on the basis of theory, and in the light of political, social and industrial considerations rather than on the basis of a satisfactory test, whether the railways shall be controlled by the Government without being owned

or controlled through Governmental ownership. The danger is that the country will drift into an answer of this question without an appreciation of its tremendous significance."

XI.

The public regulation of railway rates in Canada is not beset with some of the most formidable difficulties that have embarrassed and crippled the commissions in the United States. We have practically only two great through railways, in the main they operate under very similar territorial conditions, and by the Federal Acts declaring most of the Provincial branch railways to be roads for the general advantage of Canada the Federal Parliament would seem to have authority over the entire railway system of the country. We may be sure, however, that the validity of the laws which have authorized the summary seizure of the Provincial railways will be tested when we come to establish and attempt to operate a Federal railway commission. There are three possible courses open to the Canadian people: (1) The present system of spasmodic railway competition, and enduring and unregulated railway combination; (2) regulation and control by a strong Federal commission; (3) public ownership and operation. The third is no doubt the final solution, but it is probably remote in Canada. I do not believe that it would be sound policy to attempt to regulate great through systems by building patches of Government road in various parts of the Dominion. There is, however, much to be said in favor of natural extensions of the Intercolonial and the acquirement of natural and profitable branches of the Government railway. But in the main one must have either a system of public railways or a system of private railways. For the Government to go into the business of competition with private railways would be unwise, and would mean the adoption of a policy discredited by the experience of Germany and other countries. The result would be either the ruin of the private railways and enormous deficits at Ottawa, or the public roads would simply fetch and carry for the private corporations. In the end we would have to take over the private roads or hand our Government roads over to the private concerns, and in either case we would then find the country burdened with hundreds of miles of unnecessary railway. Our best and soundest policy for the time is to create a strong railway commission, vested with power to abolish discriminations as between particular individuals and rival communities, to force a fair interchange of traffic between rival lines, and to establish some reasonable relation between local and through charges. If we can regulate by commission we can regulate without Government railways. To adopt the double method would be costly and absurd. If we can make regulation effective over the Grand Trunk and the Canadian Pacific it would be folly to create a new great through line in order to divide the traffic and increase railway charges to the farmers and traders of the country. For every mile of new railway you construct an additional charge is laid on the people for railway support, and at least in a sparsely settled country it is only by increase of traffic that material reduction of rates can be secured.

XII.

There are grave objections, to the policy of subsidizing railways out of the Federal Treasury. Most of us are convinced that the system of Provincial subsidies was a mistake, although if we look far enough we shall probably agree that upon no other condition could we have induced the eastern Provinces to come into the Confederation and surrender their control over customs revenue. But the subsidies to Provinces are arbitrarily determined by growth of population and the terms of union. While in the case of Federal subsidies to local railways there is no fixed basis of distribution, localities and Provinces are not unlikely to engage in a competition for Federal favors, and in too many cases party considerations rather than

the public interest determine the distribution of the public money. We are fond of saying that railways should be undertaken purely as commercial enterprises; but with an empire to colonize, vast spaces to open in the west and enormous natural obstacles to overcome, and settlement scattered over wide leagues of prairie, it is doubtful if any practical government could conclude that liberal aid to pioneer roads or the construction of pioneer roads by the State was not a wise and legitimate feature of any well-considered plan of colonization. Theory counts for a good deal more in print than in government. We owe something to remote and struggling settlements, and if we proceed wisely we reap a return in growth of markets, expansion of trade and increase of revenue. It does seem clear, however, that we should vote no more public money to our great through systems, and that, richly and prodigally endowed as they have been out of the public treasury, they should now construct their own branches, and even as in the case of street railways, where they enjoy a monopoly in any rich territory, they should be required by Parliament to push out new branches as increase and extension of settlement demand.

XIII.

It seems for the moment to be the policy of Parliament to reserve running rights over new roads for possible competitors. It may be that this policy involves the continuation of the system of subsidies. In cases where heavy public subsidies are voted to aid in the construction of railways that become the property of private companies, it is perhaps not unreasonable that the State should reserve the right to give future competitors the privilege of running over rails that have been laid with public money. But in the case of roads that are built wholly by private capital, it would seem to be an extreme exercise of the public authority to give competitors, seeking to share in a business they had done nothing to create, the right to use the roadbed and station accommodation of the pioneer corporations. This policy was tried in England, but was found to operate as a very serious check to railway building, and was abandoned as unprofitable and impracticable. Perhaps all that can be said on the point is that it is a policy that can be applied to existing railways only by mutual agreement, and to such railways hereafter to be constructed as may receive large grants of public money. It was well in the case of the Crow's Nest Railway, where a mountain pass was to be held for the people, that this right of running powers should be clearly and unequivocally reserved, and it is fair to point out that a subsidy granted with this material reservation is something very different from a grant of aid without conditions. It is, in fact, almost equivalent to public ownership, and will give a roadbed through the mountains to any railway, private or national, that may hereafter be constructed across the western prairies into British Columbia. Perhaps a more practicable policy would be to acquire the right of way and build the roadbed of new railways with the money of the State and lease the rails to private corporations. This would be to stop midway between public ownership and operation and would make the final stage easy, and as it is not at all difficult to fix the carload rate per mile for freight business, public regulation of charges under such conditions could be made very effective. It seems to me it would be well to consider this policy in developing a railway system in northern Ontario, where as yet the claims and franchises of private corporations have only a slight foothold, if we are not ready to accept the more heroic policy of public construction and operation.

XIV.

One hardly finds it necessary to prove the waste of competition, the fact of combination, the existence of discriminations in Canada. There is for the time a war of passenger rates between the two great Canadian railways, but this will be

of short duration, and the settlement that will shortly be reached will probably be followed by a more rigid enforcement of the maximum charges for passenger traffic all over the Grand Trunk and Canadian Pacific systems. As to freight rates, there is an inflexible combination between the two great Canadian roads. One road will not give a reduced rate to a community or to a class of shippers except through consultation and agreement with its competitor. If ever secret discriminations are made they are probably granted to some great trading corporation or some great business house whose shipments are of very material consequence to the railway, and just as there is secret surrender to these powerful concerns the position of the ordinary shipper is prejudiced and business monopoly established. Live stock is carried from Chicago to Montreal for as low rates as are charged from points in western Ontario to the commercial capital. Grain is carried from Winnipeg to Fort William, 500 miles, for 17 1-2 cents per hundred, and from Fort William to Montreal, 1,500 miles, for 20 cents per hundred. On the main line of the Canadian Pacific the passenger rate between stations is five cents a mile all through British Columbia, while the through rate from older Canada to Vancouver is less than half a cent a mile. On freight shipped to Kamloops, Ashcroft and other points along the main line of the road in the interior of British Columbia the charge is the same as if the goods were shipped through to Vancouver and brought back two, three or four hundred miles to the point of destination. It has been established that a carload of self-binders is carried from Toronto to Australia for less than the through charge to the Northwest. A reduction of rates from Edmonton and points on the Calgary and Edmonton road gave new life to the Alberta district, and made all the difference between comparative comfort and a bare, hard living to hundreds of western settlers, and probably increased the traffic earnings of the railway. Great for adversity or for prosperity are the powers of railway corporations.

XV.

At the Union Station every day we have eloquent evidence of the waste of so-called competition. At the same hour each morning and night two great express trains start for the east, both perhaps half loaded, each carrying passengers at the same rate, making about the same time, and traversing very much the same territory. How much better it would be if we had one well-equipped, well-balanced, fast express service, and a well-ordered system of branch roads. What a waste of railway mileage we shall have on hand if we ever take over the private railways, and how important it is that we should not repeat the blunders of Ontario and Quebec in western Canada. But if we deny the people competition we must give efficient regulation, and even with satisfactory regulation we should keep always in view the probable final acquisition of the railways by the State, and strive so to distribute our new roads that the State shall not be required to take over thousands of miles of unnecessary and unproductive railways. It is estimated that in the United States there are 37,000 railway stations, that not more than eight per cent. of these are junction points, and therefore at nine-tenths of the shipping points of the country the shippers and buyers of goods must always be dependent on the facilities and rates offered by a single line of railway. In Great Britain there are about 6,000 railway stations and about 1,500 junction points. In Canada the ratio of possible competing points to the number of stations is certainly much less than in the United Kingdom, and probably lower even than in the United States. Our country, at least our developed country, is of unhappy geographical formation, and transportation over such enormous distances is very costly, and to create another through road to compete with the Grand Trunk and Canadian Pacific for Canadian traffic would be very like the enactment of a statute to impose a tax of 20 or 25 per cent. on all interprovincial trade. However effective we may be able to make a law for the regulation of common carriers, it is at

least beyond controversy that in competition there can be found no satisfactory solution of the railway problem, and we must look for the present to regulation by commission, and finally to public ownership and operation.

XVI.

A question of perhaps greater importance to the west than even the regulation of railways is the taxation of corporation lands. As the Minister of the Interior told Parliament the other day, we have 67,000,000 acres of land in Manitoba and the Northwest Territories reserved from settlement. "On that 67,000,000 of acres," said Mr. Sifton, "I, as the Minister of the Interior to-day, cannot give a man a homestead entry. Nor can I sell a single acre of it, although there are millions of acres of that land that never have been and never will be nor can be earned by any railway company. But they are reserved by order in Council, the good faith of the Dominion is pledged to that for ever, and no Government can interfere with that reserve until the bond is literally fulfilled to the last letter." Much of this land is held by the Canadian Pacific Railway Company, but there are also several millions of acres held by other railway corporations, and these lands, while not exempt from taxation by deliberate enactment, are not immediately taxable, because patents are not issued until the land is paid for by the purchaser from the railway. The clause in the Canadian Pacific charter under which its lands are exempt from Dominion, Provincial and municipal taxation, reads:—"The lands of the company in the North-West Territories, until they are either sold or occupied, shall also be free from such taxation for twenty years after the grant thereof from the Crown." The charter is dated February, 1881, and makes provision also for the granting of alternate sections of land on each side of the railway. Whether this exemption extends from the time the surveys are made and the lands become the property of the company, or from the issuing of the patents by the Government, is a point of first-rate importance. If the twenty-year exemption extends from the time the lands become the property of the company, the bulk of the railway reserve will soon become subject to taxation. If the exemption extends from the issue of the patents, it is, under existing conditions, perpetual. The company has its land secured and will take out the patents only as the land is bought by the settler. Under this interpretation the clause has the same effect as if it had simply declared the land free from taxation until sold or occupied. It is perhaps not too much to say that when the charter was granted to the syndicate the popular impression was that the exemption from taxation was to run for only twenty years, but a popular impression and the technical meaning of a railway statute are likely to bear a very different significance in the final analysis. One would think that it would be wise policy for the western railways to put their rates down to the very lowest figures that would yield a living revenue and thereby increase the value of their great landed estates. There is no doubt that low freight charges would do more than any other conceivable influence to promote settlement, and as settlement grows, as roads are made, schools opened, villages and towns established, the alternate blocks held by the railways rise in value, and the corporation grows steadily richer and richer through the sweat and toil of the settlers. The farmer who may have the ambition to acquire an adjoining railway section will feel that for every dollar of additional value his improvements give to his own property he adds to the value of the adjoining land which he aims to acquire, while he and his neighbors are refused even the privilege of imposing legitimate Provincial and municipal taxation upon these vacant spaces.

XVII.

This means practically a railway sovereignty and a subject population in the west, and there is no escape for the people from this unhappy condition except

through the exercise of the power of taxation. It is, therefore, of the very first consequence that the Government of Canada shall give early and close attention to the Land Question in the West, seek an authoritative decision from the courts as to when these lands become subject to taxation, if there be any doubt, and use to the full the power of Parliament to force the early issue of patents and to re-establish the authority of the people over the wide-stretching areas that we have rashly surrendered to railway corporations. We have here a question of tremendous import to the future of Canada, and we may be sure that as the seeds of irritation germinating at the roots of this problem spring into life and vigor, only by wise and patriotic handling of the situation will we be able to secure justice for the people without doing injustice to corporations that were deliberately created by the Parliament of Canada and deliberately endowed with these vast estates. But, even in the face of a problem like this, we may hope that this British community will move toward reform and readjustment in the spirit of justice and fair dealing, and not in the temper of confiscation and destruction. As yet there is no very serious indictment to lay against our railway corporations. The Grand Trunk, with all its mistakes and all its misfortunes, has done splendid service for the Canadian people, and we can afford to regard with kindly eye and sympathetic mind the labors of the Grand Trunk management to redeem the fortunes and restore the credit of that great pioneer in the carrying business in Canada. And as one passes over the great length of the Canadian Pacific road, with its thin fringe of population stretching for thousands of miles through wastes of rock, and wide reaches of sparsely-settled prairie, and great overhanging mountains and pioneer villages and scattered homesteads, he must conclude, despite all the clamor of the press and all the vehement eloquence of the politicians, that it is one of the marvels of this time, even when we take account of its great public subventions, that the road has been established in the financial centres of the world as a revenue-earning and dividend-paying property.

The Book tells us that there is "a time to get and a time to lose, a time to keep and a time to cast away," and it seems to me that now is the time for Canadians to get new inspiration and new courage, to cast away old prejudices, to rise superior to old quarrels and to seek a new and a common dedication to the work of building up in this new land a civilization that will have all the freedom without the license of the earlier western democracies, and that will have the stability of the old British constitutional system without the pomp and circumstance of privileged and governing classes. To my mind, the test of civilization is not in flags, or in fleets, or in armies, is not in dominion over leagues of land or over leagues of sea, but in the average material comfort and moral safety of the masses of the people. The hungry mouth is the great problem of modern civilization, and that country that can feed the multitude and have even twelve basketsful to spare will take the primacy among the nations. We should so direct our policy and so fashion our legislation that great fortunes will be hard of accumulation, that our corporations will be the servants rather than the masters of the people, and that equality of opportunity shall be preserved to all elements of the population. The danger to democracy comes from unequal social conditions, from the bare foot and the empty hand; and we, with all our rich natural heritage and all our wide, unoccupied lands, may still escape many of the evils of the old world and many of the follies of the new; may still make the remnant of the natural wealth of the country the possession of the whole people, reserve some fair percentage of the revenue from natural resources and natural opportunities for public uses and for the public treasury, and establish here in our own rich and spacious domains a freer and a better civilization than any the world has known. Many of us could, perhaps, do more than we are doing to maintain a sane public opinion in the country. There is nothing easier than to shriek the shibboleth of a mob. It is vastly easier to make an unjust attack on

a corporation than to make a just defence of a corporation. It takes courage to turn in the teeth of a mob or a wave of sectarian or national prejudice and strike a man's blows for one's own opinions. But, after all, the citizen who speaks his own mind, rests on his own judgment even in the face of press or caucus or pulpit, is the only free man and the only man worthy of representative institutions. A needless war against corporations is a menace to credit and a drag upon progress, but we are far more likely to surrender unduly to the corporation lobbyist and the concession hunter than to be over-vigilant for the rights of the people in public franchises and natural resources. We cannot hold for the people too much of what is left; we cannot too soon establish the right of control and of taxation over what has been surrendered. But, after all, the outlook is hopeful. We are neither oppressed nor in peril of war or famine. We live in a land of plenty and a time of peace. Within the past year or two there has been a wonderful upgrowth of Canadian feeling. Here at home we feel a new impulse to progress, a splendid confidence in ourselves, and across the old world the name of Canada is ringing as it never rang before. It is not a time to bicker and snarl as to what man or what party is responsible for these happy and hopeful circumstances and conditions. It is not a time to revive the memories of old quarrels and deliver judgment on the mistakes and follies of earlier days. Are we sure that we would have done better if we had had to bear the responsibilities of the fathers? Let us rather unite to honor all men who give us faithful public service, to recognize the good intent of all men who labor for the public betterment, and to make the splendid promise of to-day the more splendid achievement of to-morrow.

The golden fleece is at our feet,
Our hills are girt in sheen of gold,
Our golden-flower fields are sweet
With honey hives. A thousandfold
More fair our fruit on laden stem
Than Jordan's tow'rd Jerusalem.

THE ORIGIN OF OCEAN TIDAL SECONDARY UNDULATIONS. BY F. NAPIER
DENISON, TORONTO OBSERVATORY.

(Read April 23, 1898.)

Last year the writer had the honor of reading before the members of this Institute a short paper, entitled "A Probable Solution of the Secondary Undulations Found Upon Ocean Tidal Records." As the information then obtainable was extremely limited, the important points were set forth as suggestions for criticism. Since the publication and widespread distribution of your valuable "Proceedings" containing this paper, the writer has received numerous encouraging letters bearing upon this subject from various quarters of the globe.

In order to still further pursue this most engrossing and what is to be hoped valuable investigation, arrangements were made by Mr. Stupart, Director of our Service with the Marine Department at Ottawa, whereby the writer was granted free access to all the Canadian Tidal records now under Mr. M. W. Bell Dawson, Engineer in charge of the Tidal Survey, who also assisted me in every way possible. Tracings were made from over 1,000 daily tidal records, showing different types of undulations, from the following stations:—Halifax, Anticosti, St. Paul Island, Forteau Bay, St. John, N.B., Father Point, and Point Levis; also the original records were obtained from the temporary tidal stations at Carleton, P.Q., Pictou, N.S., Souris, P.E.I., St. Peter's Bay, P.E.I., and the Grindstone Island Barograph records from 1893-1894 to study with the corresponding Anticosti tidal traces, also tracings from several St. John, N.B., barograms. Upon returning to Toronto these records were carefully studied in conjunction with the corresponding synoptic weather charts at the Observatory. The result of this investigation clearly demonstrated that these undulations are due to the direct action of atmospheric waves or billows, as they pass over the harbours or bays, which tend to form minute undulations upon the surface of the water, and as these small water undulations advance farther into semi-enclosed basins become magnified as they reach narrower and shallower portions where the tide gauges are situated. Permit me briefly to summarize what has already been observed by others bearing upon this interesting subject.

In 1838 this phenomenon was observed at Swansea, England, where a regular time interval of from fifteen to twenty minutes was noted. Some of these records were sent to Sir George Airy, who was then unable to account for them. Admiral Smythe referred to this phenomenon at Malta, where it had long been termed "Mirobia," and supposed to be due to distant storms. In 1878 Sir George Airy read a paper before the Royal Society upon the tides of Malta, in which he speaks of these undulations as simple harmonic curves, whose heads are sometimes notched as by the intermixture of small waves. That they had a marked time interval of twenty-one minutes and a range of twelve inches amplitude, much exceeding that of the lunar tides. He believed they were "seiches" similar to those discovered by Forel upon the Swiss lakes, and supposed them due to a reflexive action from the shores of Sicily and the African coast. Major Baird, of the Indian Tidal Survey, referred to this phenomenon in 1868 as being most pronounced at the ends of bays, but offered no explanation. In 1896 Professor Duff, of Purdue University, studied these undulations at St. John, N.B., and Indiantown, and later presented a paper before the Royal Society of Canada, in which he also classes them as "seiches," due to some form of oscillation between the two sides of the Bay of Fundy. He does not attempt any explanation for the abnormal movements often observed during fine settled weather. Mr. H. C. Russell, of New South Wales,

states that at Sydney what have been previously termed earthquake waves are in most cases due to atmospheric disturbances in some yet ill-defined manner, and have a marked twenty-six minute time interval from crest to crest.

Finally, these undulations are universal to a greater or less extent, as has been proved by a personal study of tidal records obtained from all parts of the world.

CHIEF POINTS DEDUCED.

1. That the undulations are due to the direct action of atmospheric waves upon the surface of the water at stations, and not to ground swells due to distant storms or "seiche" movements, as found upon lakes during atmospheric disturbances.

2. There is a marked relative correspondence in amplitude between the barometric and water undulations.

3. That they often appear during fine settled weather, when the barometer is high over the station but decidedly low to the south-west, frequently when over 1,000 miles distant.

4. That they increase in amplitude as the storm advances, the maximum usually occurring shortly before and at the time of the shift of wind, which also corresponds with the time of heaviest precipitation. This tends to prove that the axis of rotation of important storms is inclined towards the direction of its future course.

5. That after the storm has passed the station, these undulations rapidly diminish, although a heavy westerly gale may still be blowing, provided the temperature to the westward is fairly uniform: should a cold or warm wave be approaching marked undulations appear.

6. Should a south-west storm move with diminishing energy towards the station the undulations correspondingly decrease as it approaches.

7. That the tidal records are most disturbed during winter and least in summer, due to the velocity of the primary poleward current being almost double in winter what it is during the summer months.

8. The disturbed traces during the summer months chiefly occur shortly before or at the time of showers or thunderstorms, and usually precede warm and cool waves.

9. Whereas many of our storms are whirling eddies, developing from above downwards, it is hoped a further study of these undulations may throw much light upon their future growth and course, even before the ordinary barometer begins to fall.

10. Meteorologists throughout the scientific world now realize that for the further advancement of weather forecasting a better knowledge of the upper atmosphere must be obtained. Rapid strides are now being made in this direction by means of kites, balloons and cloud observations. May we not add the study of atmospheric and water waves at the bottom of this aerial ocean, which can be carried on during all conditions of weather by means of sensitive self-recording instruments?*

The various traces, termed "hydro-aerographs," obtained from such instruments, when more fully understood, will indicate to us certain wonderful forces at work far above, not visually discernible either through the dense lower clouds of an approaching storm or the clear blue sky of a fine winter's day. Also we trust that in the near future the installation of such instruments will become universal, and that Canada will lead in such an undertaking.

*Fully described in a paper read before the Toronto meeting of the British Association in August, 1897.