TRAIL SMELTER ARBITRAL TRIBUNAL.

DECISION

REPORTED ON APRIL 16, 1938, TO THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND TO THE GOVERNMENT OF THE DOMINION OF CANADA UNDER THE CONVENTION SIGNED APRIL 15, 1935.

This Tribunal is constituted under, and its powers are derived from and limited by, the Convention between the United States of America and the Dominion of Canada signed at Ottawa, April 15, 1935, duly ratified by the two parties, and ratifications exchanged at Ottawa, August 3, 1935 (hereinafter termed "the Convention").

By Article II of the Convention, each Government was to choose one member of the Tribunal, "a jurist of repute", and the two Governments were to choose jointly a Chairman who should be a "jurist of repute and neither a British subject nor a citizen of the United States".

The members of the Tribunal were chosen as follows: by the United States of America, Charles Warren of Massachusetts; by the Dominion of Canada, Robert A. E. Greenshields of the Province of Quebec; by the two Governments jointly, Jan Frans Hostie of Belgium.

Article II, paragraph 4, of the Convention provided that "the Governments may each designate a scientist to assist the Tribunal"; and scientists were designated as follows: by the United States of America, Reginald S. Dean of Missouri; and by the Dominion of Canada, Robert E. Swain of California. The Tribunal desires to record its appreciation of the valuable assistance received by it from these scientists.

The duty imposed upon the Tribunal by the Convention was to "finally decide" the following questions:

(1) Whether damage caused by the Trail Smelter in the State of Washington has occurred since the first day of January, 1932, and, if so, what indemnity should be paid therefor?

(2) In the event of the answer to the first part of the preceding question being in the affirmative, whether the Trail Smelter should be required to refrain from causing damage in the State of Washington in the future and, if so, to what extent?

(3) In the light of the answer to the preceding question, what measures or régime, if any, should be adopted or maintained by the Trail Smelter?

(4) What indemnity or compensation, if any, should be paid on account of any decision or decisions rendered by the Tribunal pursuant to the next two preceding questions?

The Tribunal met in Washington, in the District of Columbia, on June 21, 22, 1937, for organization, adoption of rules of procedure and hearing of preliminary statements. From July 1 to July 6, it travelled over and inspected the area involved in the controversy in the northern part of Stevens County in the State of Washington and it also inspected the smelter plant of the Consolidated Mining and Smelting Company of Canada, Limited, at Trail in British Columbia. It held sessions for the reception and consideration of such evidence, oral and documentary, as was presented by the Governments or by interested parties, as provided in Article VIII, in Spokane in the State of Washington, from July 7 to July 29, 1937; in Washington, in the District of Columbia, on August 16, 17, 18, 19, 1937; in Ottawa, in the Province of Ontario, from August 23 to September 18, 1937; and it heard arguments of counsel in Ottawa from October 12 to October 19, 1937.

On January 2, 1938, the Agents of the two Governments jointly informed the Tribunal that they had nothing additional to present. Under the provisions of Article XI of the Convention, it then became the duty of the Tribunal "to report to the Governments its final decisions .... and within a period of three months after the conclusion of the proceedings", *i.e.*, on April 2, 1938.

After long consideration of the voluminous typewritten and printed record and of the transcript of evidence presented at the hearings, the Tribunal formally notified the Agents of the two Governments that, in its opinion, unless the time limit should be extended, the Tribunal would be forced to give a permanent decision on April 2, 1938, on the basis of data which it considered inadequate and unsatisfactory. Acting on the recommendation of the Tribunal and under the provisions of Article XI authorizing such extension, the two Governments by agreement extended the time for the report of final decision of the Tribunal to three months from October 1, 1940.

The Tribunal is prepared now to decide finally Question No. 1, propounded to it in Article III of the Convention; and it hereby reports its final decision on Question No. 1, its temporary decision on Questions No. 2 and No. 3, and provides for a temporary régime thereunder and for a final decision on these questions and on Question No. 4, within three months from October 1, 1940.

Wherever, in this decision, the Tribunal has referred to decisions of American courts or has followed American law, it has acted pursuant to Article IV as follows: "The Tribunal shall apply the law and practice followed in dealing with cognate questions in the United States of America ...."

In all the consideration which the Tribunal has given to the problems presented to it, and in all the conclusions which it has reached, it has been guided by that primary purpose of the Convention expressed in the words of Article IV, that the Tribunal "shall give consideration to the desire of the high contracting parties to reach a solution just to all parties concerned", and further expressed in the opening paragraph of the Convention as to the "desirability and necessity of effecting a permanent settlement" of the controversy.

The controversy is between two Governments involving damage occurring in the territory of one of them (the United States of America) and alleged to be due to an agency situated in the territory of the other (the Dominion of Canada), for which damage the latter has assumed by the Convention an international responsibility. In this controversy, the Tribunal is not sitting to pass upon claims presented by individuals or on behalf of one or more individuals by their Government, although individuals may come within the meaning of "parties concerned", in Article IV and of

"interested parties", in Article VIII of the Convention and although the damage suffered by individuals may, in part, "afford a convenient scale for the calculation of the reparation due to the State" (see Jugdment No. 13, Permanent Court of International Justice, Series A, No. 17, pp. 27, 28).

PART ONE.

By way of introduction to the Tribunal's decision, a brief statement, in general terms, of the topographic and climatic conditions and economic history of the locality involved in the controversy may be useful.

The Columbia River has its source in the Dominion of Canada. At a place in British Columbia named Trail, it flows past a smelter located in a gorge, where zinc and lead are smelted in large quantities. From Trail, its course is easterly and then it swings in a long curve to the International Boundary Line, at which point it is running in a southwesterly direction; and its course south of the boundary continues in that general direction. The distance from Trail to the boundary line is about seven miles as the crow flies or about eleven miles, following the course of the river (and possibly a slightly shorter distance by following the contour of the valley). At Trail and continuing down to the boundary and for a considerable distance below the boundary, mountains rise on either side of the river in slopes of various angles to heights ranging from 3,000 to 4,500 feet above sea-level, or between 1,500 to 3,000 feet above the river. The width of the valley proper is between one and two miles. On both sides of the river are a series of bench lands at various heights.

More or less half way between Trail and the boundary is a place, on the east side of the river, known as Columbia Gardens; at the boundary on the American side of the line and on the east side of the river, is a place known as Boundary; and four or five miles south of the boundary on the east bank of the river is a farm named after its owner, Stroh farm. These three places are specially noted since they are the locations of automatic sulphur dioxide recorders installed by one or other of the Governments. The town of Northport is located on the east bank of the river, about nineteen miles from Trail by the river, and about thirteen miles as the crow flies, and automatic sulphur dioxide recorders have been installed here and at a point on the west bank northerly of Northport. It is to be noted that mountains extending more or less in an easterly and westerly direction rise to the south between Trail and the boundary.

Various creeks are tributary to the river in the region of Northport, as follows: Deep Creek flowing from southwest to northwest and entering the river slightly north of Northport; opposite Deep Creek and entering on the west side of the river and flowing from the northwest, Sheep Creek; north of Sheep Creek on the west side, Nigger Creek; south of Sheep Creek on the west side, Squaw Creek; south of Northport, on the east side, flowing from the southeast, Onion Creek.

About eight miles south of Northport, following the river, is the town of Marble; and about seventeen miles, the town of Bossburg. Three miles south of Bossburg is the town of Evans; and about nine miles, the town of Marcus. South of Marcus and about forty-one miles from the boundary line is the town of Kettle Falls which, in general, may be stated to be the southern limit of the area as to which evidence was presented. All the above towns are small in population and in area.

At Marble and to the south, various other creeks enter the river from the west side—Rattlesnake Creek, Crown Creek, Flat Creek, and Fifteen Mile Creek.

Up all the creeks above mentioned, there extend tributary valleys, differing in size.

While, as stated above, the width of the valley proper of the river is from one to two miles, the width of the valley measured at an altitude of 3,000 feet above sea-level, is approximately three miles at Trail, two and one-half miles at Boundary, four miles above Northport, three and one-half miles at Marble. Near Bossburg and southward the valley at the same altitude broadens out considerably.

As to climatic conditions, it may be stated that the region is, in general, a dry one though not what is termed "arid". The average annual precipitation at Northport from 1923 to 1936 inclusive averaged slightly below seventeen inches. It varied from a minimum of 9.60 inches in 1929 to a maximum of 26.04 inches in 1927. The average crop-year precipitation over the same period is slightly over sixteen inches, with a variation from a minimum of 10.10 inches in 1929 to a maximum of 24.01 in 1927. The rainfall in the growing-season months of April, May and June at Northport, has been in 1932, 5.43 inches; in 1933, 3.03 inches; in 1934, 2.74 inches; in 1933, 2.02 inches; in 1929, 4.44 inches. The average snowfall was reported in 1915 by United States Government agents as fifty-eight inches at Northport. The average humidity varies with some regularity from day to day. In June, 1937, at Northport, it had an average maximum of 74 per cent at 5 a.m. and an average minimum of 26 per cent at 5 p.m.

The range of temperature in the different months as it appears from the records of the years 1934, 1935, and 1936, at Northport was as follows: In the months of November, December, January and February, the lowest temperature was 1° (in January, 1936), and the highest was 60° (in November 1934); in the growing-season months of April, May, June and July, the lowest temperature was 12° (in April, 1936), and the highest was 110° (in July, 1934); in the remaining months of August, September, October and March, the lowest temperature was 8° (in October, 1935), and the highest was 102° (in August, 1934).

The direction of the surface wind is, in general, from the northeast down the river valley, but this varies at different times of day and in different seasons. The subject of winds is treated in detail in a later part of this decision and need not be considered further at this point.

The history of what may be termed the economic development of the area may be briefly stated as follows: Previous to 1892, there were few settlers in this area, but homesteading and location of farms received an impetus, particularly on the east side of the river, at the time when the construction of the Spokane and Northern Railway was undertaken, which was completed between the City of Spokane and Northport in 1892, and extended to Nelson in British Columbia in 1893. In 1892, the town of Northport was founded. The population of Northport, according to the United States Census in 1900, was 787; in 1910, it was 476; in 1920, it was 906; and in 1930, it was 391. The population of the area which may be termed, in general, the "Northport Area", according to the United States Census in 1910, was 1,448; in 1920, it was 2,142; and in 1930, it was 1,121. The population of this area as divided into the Census Precincts was as follows:

	1900	*1910*	*1920*	*1930*
Boundary	74	91	73	87
Northport	845	692	1,093	510
Nigger Creek	...	27	97	29
Frontier	...	103	71	22
Cummins	...	...	244	89
Doyle	...	187	280	195
Deep Creek	65	119	87	81
Flat Creek	52	126	137	71
Williams	71	103	60	37

(It is to be noted that the precincts immediately adjacent to the boundary line were Frontier, Nigger Creek and Boundary; and that Frontier and Nigger Creek Precincts are at the present time included in the Northport Precinct.)

The area of all land in farms in the above precincts, according to the United States Census of Agriculture in 1925 was 21,551 acres; in 1930, 28,641 acres; and in 1935, 24,772 acres. The area in crop land in 1925 was 3,474 acres; in 1930, 4,285 acres; and in 1933, 4,568 acres. The farm population in 1925 was 496; in 1930, 603; and in 1935, 466.

In the precincts nearest the boundary line, *viz.*, Boundary and Northport (including Frontier and Nigger Creek prior to 1935 Census), the area of all land in farms in 1925 was 5,292 acres; in 1930, 8,040 acres; and in 1935, 5,666 acres. The area in crop land in 1925 was 798 acres; in 1930, 1,227 acres; and in 1935, 963 acres. The farm population in 1925 was 149; in 1930, 193; and in 1935, 145.

About the year 1896, there was established in Northport a business which has been termed the "Breen Copper Smelter", operated by the LeRoi Mining and Smelting Company, and later carried on by the Northport Smelting and Refining Company which was chartered in 1901. This business employed at times from five hundred to seven hundred men, although, as compared with a modern smelter like the Trail Smelter, the extent of its operations was small. The principal value of the ores smelted by it was in copper, and the ores had a high sulphur content. For some years, the somewhat primitive method of "heap roasting" was employed which consisted of roasting the ore in open piles over woodfires, frequently called in mining parlance, "stink piles". Later, this process was changed. About seventy tons of sulphur were released per day. This Northport Smelting and Refining Company intermittently continued operations until 1908. From 1908 until 1915, its smelter lay idle. In March, 1916, during the Great War, operation was resumed for the purpose of smelting lead ore, and continued until March 5, 1921, when it ceased business and its plant was dismantled. About 30 tons of sulphur per day were emitted during this time. There is no doubt that damage was caused to some extent over a more or less restricted area by the operation of this smelter plant.

The record and evidence placed before the Tribunal does not disclose in detail claims for damage on account of fumigations which were made between 1896 and 1908, but it does appear that there was considerable litigation in Stevens County courts based on such claims. It also appears in evidence that prior to 1908, the company had purchased smoke easements from sixteen owners of land in the vicinity covering 2,330 acres. It further appears that from 1916 to 1921, claims for damages were made and suits

were brought in the courts, and additional smoke easements were purchased from thirty-four owners of land covering 5,556.7 acres. These various smoke easements extended to lands lying four or five miles north and three miles south and three miles east of Northport and on both sides of the river, and they extended as far as the boundary line.

In addition to the smelting business, there have been intermittent mining operations of lead and zinc in this locality, but they have not been a large factor in adding to the population.

The most important industry in the area in the past has been the lumber industry. It had its beginning with the building of the Spokane & Northern Railway. Several saw mills were constructed and operated, largely for the purpose of furnishing ties to the railway. In fact, the growing trees—yellow pine, Douglas fir, larch, and cedar—were the most valuable asset to be transformed into ready cash. In early days, the area was rather heavily wooded, but the timber has largely disappeared and the lumber business is now of small size. It appears from the record in 1929 that, within a radius covering some thirty-five thousand acres surrounding Northport, fifteen out of eighteen sawmills had been abandoned and only three of the small type were in operation. The causes of this condition are in dispute. A detailed description of the forest conditions is given in a later part of this decision and need not be further discussed here.

As to agricultural conditions, it may be said that farming is carried on in the valley and upon the benches and mountain slopes and in the tributary valleys. The soils are of a light, sandy nature, relatively low in organic matter, although in the tributary valleys the soil is more loamy and fertile. In some localities, particularly on the slopes, natural sub-irrigation affords sufficient moisture; but in other regions irrigation is desirable in order to produce favorable results. In a report made by Dr. F. C. Wyatt, head of the Soils Department of the University of Alberta, in 1929, it is stated that "taken as a unit, the crop range of these soils is wide and embraces the crops suited to the climate conditions. Under good cultural operations, yields are good." At the same time, it must be noted that a large portion of this area is not primarily suited to agriculture. In a report of the United States Department of Agriculture, in 1913, it is stated that "there is approximately one-third of the land in the Upper Columbia Basin unsuited for agricultural purposes, either because it is too stony, too rough, too steep, or a combination of these factors. To utilize this large proportion of land and to meet the wood needs of an increasing population, the Upper Columbia Basin is forced to consider seriously the problem of reforestation and conservation." Much of the farming land, especially on the benches, is land cleared from forest growth; most of the farms contain from an eighth to a quarter of a section (80-160 acres); and there are many smaller and some larger farms.

In general, the crops grown on the farms are alfalfa, timothy, clover, grain cut green for hay, barley, oats, wheat, and a small amount of potatoes. Wild hay is cut each year to some extent. The crops, in general, are grown for feed rather than for sale, though there is a certain amount of wheat and oats sold. Much of the soil is apparently well suited to the predominant crop of alfalfa, which is usually cut at present twice a year (with a small third crop on some farms). Much of the present alfalfa has been rooted for a number of years.

Milch cattle are raised to a certain extent and they are grazed on the wild grasses on the hills and mountains in the summer months, but the dairying

business depends on existence of sufficient land under cultivation as an adjunct to the dairy to provide adequate forage for the winter months.

In early days, it was believed that, owing to soil and climatic conditions, this locality was destined to become a fruit-growing region, and a few orchards were planted. For several reasons, of which it is claimed that fumigation is one, orchards have not thrived. In 1909-1910, the Upper Columbia Company purchased two large tracts, comprising about ten thousand acres, with the intention of developing the land for orchard purposes and selling of timber in the meantime, and it established a large orchard of about 900 acres in the town of Marble. The project, as early as 1917, proved a failure.

In 1896, a smelter was started under American auspices near the locality known as Trail. In 1906, the Consolidated Mining and Smelting Company of Canada, Limited, obtained a charter of incorporation from the Canadian authorities, and that company acquired the smelter plant at Trail as it then existed. Since that time, the Canadian Company, without interruption, has operated the Smelter, and from time to time has greatly added to the plant until it has become one of the best and largest equipped smelting plants on this continent. In 1925 and 1927, two stacks of the plant were erected to 409 feet in height and the Smelter greatly increased its daily smelting of zinc and lead ores. This increased product resulted in more sulphur dioxide fumes and higher concentrations being emitted into the air; and it is claimed by one Government (though denied by the other) that the added height of the stacks increased the area of damage in the United States. In 1916, about 5,000 tons of sulphur per month were emitted; in 1924, about 4,700 tons; in 1926, about 9,000 tons—an amount which rose near to 10,000 tons per month in 1903. In other words, about 300-350 tons of sulphur were being emitted daily in 1930. (It is to be noted that one ton of sulphur is substantially the equivalent of two tons of sulphur dioxide or SO_2.)

From 1925, at least, to the end of 1931, damage occurred in the State of Washington, resulting from the sulphur dioxide emitted from the Trail Smelter.

As early as 1925 (and there is some evidence earlier) suggestions were made to the Trail Smelter that damage was being done to property in the northern part of Stevens County. The first formal complaint was made, in 1926, by one J. H. Stroh, whose farm (mentioned above) was located a few miles south of the boundary line. He was followed by others, and the Smelter Company took the matter up seriously and made a more or less thorough and complete investigation. This investigation convinced the Trail Smelter that damage had been and was being done, and it proceeded to negotiate with the property owners who had made complaints or claims with a view to settlement. Settlements were made with a number of farmers by the payment to them of different amounts. This condition of affairs seems to have lasted during a period of about two years. In June, 1928, the County Commissioners of Stevens County adopted a resolution relative to the fumigations; and on August 25, 1928, there was brought into existence an association known as the "Citizens' Protective Association". Due to the creation of this association or to other causes, no settlements were made thereafter between the Trail Smelter and individual claimants, as the articles of association contained a provision that "no member herein shall make any settlement for damages sought to be secured herein, unless the written consent of the majority of the Board of Directors shall have been first obtained".

It has been contended that either by virtue of the Constitution of the State of Washington or of a statute of that State, the Trail Smelter (a Canadian corporation) was unable to acquire ownership or smoke easements over real estate, in the State of Washington, in any manner. In regard to this statement, either as to the fact or as to the law, the Tribunal expresses no opinion and makes no ruling.

The subject of fumigations and damage claimed to result from them was first taken up officially by the Government of the United States in June, 1927, in a communication from the Consul General of the United States at Ottawa, addressed to the Government of the Dominion of Canada.

In December, 1927, the United States Government proposed to the Canadian Government that problems growing out of the operation of the Smelter at Trail should be referred to the International Joint Commission, United States and Canada, for investigation and report, pursuant to Article IX of the Convention of January 11, 1909, between the United States and Great Britain. Following an extensive correspondence between the two Governments, they joined in a reference of the matter to that Commission under date of August 7, 1928. It may be noted that Article IX of the Convention of January 11, 1909, provides that the high contracting parties might agree that "any other question or matters of difference arising between them involving the rights, obligations or interests of either in relation to the other, or to the inhabitants of the other, along the common frontier between the United States and the Dominion of Canada shall be referred from time to time to the International Joint Commission for examination and report. . . . Such reports shall not be regarded as decisions of the question or matters so submitted either on the facts or on the law, and shall not, in any way, have the character of an arbitral award."

The questions referred to the International Joint Commission were five in number, the first two of which may be noted: First, the extent to which property in the State of Washington has been damaged by fumes from Smelter at Trail, B.C.; second, the amount of indemnity which would compensate United States interests in the State of Washington for past damages.

The International Joint Commission sat at Northport to take evidence and to hear interested parties in October, 1928; in Washington, D.C., in April, 1929; at Nelson in British Columbia in November, 1929; and final sittings were held in Washington, D.C., on January 22 and February 12, 1930. Witnesses were heard; reports of the investigations made by scientists were put in evidence; counsel for both the United States and Canada were heard, and briefs submitted; and the whole matter was taken under advisement by the Commission. On February 28, 1931, the Report of the Commission was signed and delivered to the proper authorities. The report was unanimous and need not be considered in detail.

Paragraph 2 of the report, in part, reads as follows:

> In view of the anticipated reduction in sulphur fumes discharged from the Smelter at Trail during the present year, as hereinafter referred to, the Commission therefore has deemed it advisable to determine the amount of indemnity that will compensate United States interests in respect of such fumes, up to and including the first day of January, 1932. The Commission finds and determines that all past damages and all damages up to and including the first day of January next, is the sum of $350,000. Said sum, however, shall not include any damage occurring after January 1, 1932.

In paragraph 4 of the report, the Commission recommended a method of indemnifying persons in Washington State for damage which might be caused by operations of the Trail Smelter after the first of January, 1932, as follows:

> Upon the complaint of any persons claiming to have suffered damage by the operations of the company after the first of January, 1932, it is recommended by the Commission that in the event of any such claim not being adjusted by the company within a reasonable time, the Governments of the United States and Canada shall determine the amount of such damage, if any, and the amount so fixed shall be paid by the company forthwith.

This recommendation, apparently, did not commend itself to the interested parties. In any event, it does not appear that any claims were made after the first of January, 1932, as contemplated in paragraph 4 of the report.

In paragraph 5 of the report, the Commission recommended that the Consolidated Mining and Smelting Company of Canada, Limited, should proceed to erect and put in operation certain sulphuric acid units for the purpose of reducing the amount of sulphur discharged from the stacks. It appears, from the evidence in the present case, that the General Manager of the company had made certain representations before the Commission as to the intentions of the company in this respect. There is a conflict of testimony as to the exact scope of these representations, but it is unnecessary now to consider the matter further, since, whatever they were, the company proceeded after 1930 to make certain changes and additions. With the intention and purpose of lessening the sulphur contents in the smoke emissions at the stacks, the following installations (amongst others) have been made in the plant since 1931; three 112 tons sulphuric acid plants in 1931; ammonia and ammonium sulphate plant in 1931; two units for reduction and absorption of sulphur in the zinc smelter, in 1936 and 1937, and an absorption plant for gases from the lead roasters in June, 1937. In addition, in an attempt to lessen injurious fumigations, a new system of control over the emission of fumes during the crop-growing season has been in operation, particularly since May, 1934. It is to be noted that the chief sulphur contents are in the gases from the lead smelter, but that there is still a certain amount of sulphur content in the fumes from the zinc smelter. As a result of the above, as well as of depressed business conditions, the tons of sulphur emitted into the air from the plants fell from about 10,000 tons per month in 1930 to about 7,200 tons in 1931, and to 3,400 tons in 1932. The emission of sulphur rose in 1933 to 4,000 tons, and in 1934 to nearly 6,300 tons, and in 1935 to 6,800 tons. In 1936, it fell to 5,600 tons; and in January to July, 1937 inclusive, it was 4,750 tons.

Two years after the signing of the International Joint Commission's Report of February 28, 1931, the United States Government on February 17, 1933, made representations to the Canadian Government that existing conditions were entirely unsatisfactory and that damage was still occurring, and diplomatic negotiations were renewed. Correspondence was exchanged between the two countries, and although that correspondence has its importance, it is sufficient here to say, that it resulted in the signing of the present Convention.

Consideration of the terms of that Convention is given more in detail in the later parts of the Tribunal's decision.

PART TWO.

The first question under Article III of the Convention which the Tribunal is required to decide is as follows:

> (1) Whether damage caused by the Trail Smelter in the State of Washington has occurred since the first day of January, 1932, and, if so, what indemnity should be paid therefor.

In the determination of the first part of this question, the Tribunal has been obliged to consider three points, *viz.*, the existence of injury, the cause of the injury, and the damage due to the injury.

The Tribunal has interpreted the word "occurred" as applicable to damage caused prior to January 1, 1932, in so far as the effect of the injury made itself felt after that date. The words "Trail Smelter" are interpreted as meaning the Consolidated Mining and Smelting Company of Canada, Limited, its successors and assigns.

In considering the second part of the question as to indemnity, the Tribunal has been mindful at all times of the principle of law which is set forth by the United States courts in dealing with cognate questions, particularly by the United States Supreme Court in Story Parchment Company *v.* Paterson Parchment Paper Company (1931), 282 U. S. 555 as follows: "Where the tort itself is of such a nature as to preclude the ascertainment of the amount of damages with certainty, it would be a perversion of fundamental principles of justice to deny all relief to the injured person, and thereby relieve the wrongdoer from making any amend for his acts. In such case, while the damages may not be determined by mere speculation or guess, it will be enough if the evidence show the extent of the damages as a matter of just and reasonable inference, although the result be only approximate." (See also the decision of the Supreme Court of Michigan in Allison *v.* Chandler, 11 Michigan 542, quoted with approval by the United States Supreme Court, as follows: "But shall the injured party in an action of tort, which may happen to furnish no element of certainty, be allowed to recover no damages (or merely nominal), because he cannot show the exact amount with certainty, though he is ready to show, to the satisfaction of the jury, that he has suffered large damages by the injury? Certainty, it is true, would thus be attained; but it would be the certainty of injustice. . . . Juries are allowed to act upon probable and inferential, as well as direct and positive proof.")

The Tribunal has first considered the items of indemnity claimed by the United States in its Statement (p. 52) "on account of damage occurring since January 1, 1932, covering: (a) Damages in respect of cleared land and improvements thereon; (b) Damages in respect of uncleared land and improvements thereon; (c) Damages in respect of livestock; (d) Damages in respect of property in the town of Northport; (g) Damages in respect of business enterprises".

With respect to Item (a) and to Item (b), *viz.*, "Damages in respect of cleared land and improvements thereon", and "Damages in respect of uncleared land and improvements thereon", the Tribunal has reached the conclusion that damage due to fumigations has been proved to have occurred since January 1, 1932, and to the extent set forth hereafter.

Since the Tribunal has concluded that, on all the evidence, the existence of injury has been proved, it becomes necessary to consider next the cause of injury. This question resolves itself into two parts—first, the actual caus-

ing factor, and second, the manner in which the causing factor has operated. With reference to causation, the Tribunal desires to make the following preliminary general observations, as to some of the evidence produced before it.

(1) The very satisfactory data from the automatic sulphur dioxide recorders installed by each of the Governments, covering large portions of each year from 1931 to 1937, have been of great value in this controversy. These records have thrown much light upon the nature, the durations, and the concentrations of the fumigations involved; and they will prove of scientific value in any future controversy which may arise on the subject of fumigations.

(2) The experiments conducted by the United States at Wenatchee in the State of Washington and by Canada at Summerland in British Columbia, and the experiments conducted by scientists elsewhere, the results of which have been testified to at length before the Tribunal, have been of value with respect to the effects of sulphur dioxide fumigations on plant life and on the yield of crops. While the Canadian experiments were more extensive than the American, and were carried out under more satisfactory conditions, the Tribunal feels that the number of experiments was still too limited to warrant in all cases so positive conclusions as witnesses were inclined to draw from them; and on the question of the effect of fumigations on the yield of crops, it seems probable that more extensive experimentation would have been desirable, especially since, while the total number of experiments was large, the number devoted to establishing each type of result was in most cases rather small. Moreover, conditions in experimental fumigation plots can rarely exactly reproduce conditions in the field; and there was some evidence that injury occurred on various occasions to plant life in the field, under durations and degrees of concentration which never produced injury to plant life in the experimental plots.

(3) Valuable evidence as to the actual condition of crops in the field was given by experts on both sides, and by certain non-expert witnesses. Unfortunately, such field observations were not made continuously in any crop season or in all parts of the area of probable damage; and, even more unfortunately, they were not made simultaneously by the experts for the two countries, who acted separately and without comparing their conclusions with each other contemporaneously.

(4) The effects of sulphur dioxide fumigations upon the forest trees, especially upon the conifers, were testified to at great length by able experts, and their studies in the field and in the experimental plots, with reference to mortality, deterioration, retardation of ring growth and shoot growth, sulphur content of needles, production of cones and reproduction in general, have been of great value. As is usual in this type of case, though the poor condition of the trees was not controverted, experts were in disagreement as to the cause—witnesses for the United States generally finding the principal cause of injury to be sulphur dioxide fumigations, and witnesses for Canada generally attributing the injury principally to ravages of insects, diseases, winter and summer droughts, unwise methods of logging, and forest and ground fires. It is possible that each side laid somewhat too great emphasis on the causes for which it contended.

(5) Evidence was produced by both sides as to experimental tests of the sulphur contents of the soils and of the waters in the area. These tests, however, were, for the most part, too limited in number and in location to afford a satisfactory basis from which to draw absolutely positive conclusions.

In general, it may be said that the witnesses expressed contrary views and arrived at opposite conclusions, on most of the questions relating to cause of injury.

The Tribunal is of opinion that the witnesses were completely honest and sincere in their views and that the expert witnesses arrived at their conclusions as the integral result of their high technical skill. At the same time, it is apparent that remarks are very pertinent, such as were made by Judge Johnson in the United States District Court (Anderson *v.* American Smelting & Refining Co., 265 Federal Reporter 928) in 1919:

> Plaintiff's witnesses give it as their opinion and best judgment that SO_2 was the cause of the injuries appearing upon the plants in the field; defendants' witnesses in like manner express the opinion and give it as their best judgment that the injury observed was caused by something else other than SO_2. It must not be overlooked that witnesses who give opinion evidence are sometimes unconsciously influenced by their environment, and their evidence colored, if not determined, by their point of view. The weight to be given to such evidence must be determined in the light of the knowledge, the training, the power of observation and analysis, and in general the mental equipment, of each witness, assuming, as I do, that the witnesses of the respective parties were honest and intended to testify to the truth as they perceived it. . . . The expert witnesses called by plaintiffs, who made a survey of the affected area, made valuable observations; but seem to have assumed as a basis for their conclusions that leaf markings having the appearance of SO_2 injury were in fact SO_2 injury—an unwarranted generalization. . . . It is quite evident that the testimony of witnesses whose mental attitude is to account for every injury as produced by some other cause is no more convincing than the testimony of witnesses who attribute every injury similar in appearance to SO_2 injury to SO_2 as the sole and only cause. The expert witnesses of defendants manifested the same general mental attitude; that is to say, they were able to find a sufficient cause operating in any particular case other than SO_2, and therefore gave it as their opinion that such other cause was the real cause of the injury, or markings observed. The real value I find in the testimony of these opinion witnesses of the parties lies in their description of appearances and statement of the surrounding circumstances, rather than in their ultimate expressed opinions. I have no doubt of the accuracy of the experiments made by the expert and scientific witnesses called by the parties.

On the basis of the evidence, the United States contended that damage had been caused by the emission of sulphur dioxide fumes at the Trail Smelter in British Columbia, which fumes, proceeding down the valley of the Columbia River and otherwise, entered the United States. The Dominion of Canada contended that even if such fumes had entered the United States, they had caused no damage after January 1, 1932. The witnesses for both Governments appeared to be definitely of the opinion that the gas was carried from the Smelter by means of surface winds, and they based their views on this theory of the mechanism of gas distribution. The Tribunal finds itself unable to accept this theory. It has, therefore, looked for a more probable theory, and has adopted the following as permitting a more adequate correlation and interpretation of the facts which have been placed before it.

It appears from a careful study and comparison of recorder data furnished by the two Governments, that on numerous occasions fumigations occur practically simultaneously at points down the valley many miles apart—this being especially the fact during the growing season from April to October. It also appears from the data furnished by the different recorders, that the rate of gas attenuation down the river does not show a constant trend, but is more rapid in the first few miles below the boundary and more gradual further down the river. The Tribunal finds it impossible satisfactorily to account for the above conditions, on the basis of the theory presented to it. The Tribunal finds it further difficult to explain the times and durations of the fumigations on the basis of any probable surface-wind conditions.

The Tribunal is of opinion that the gases emerging from the stacks of the Trail Smelter find their way into the upper air currents, and are carried by these currents in a fairly continuous stream down the valley so long as the prevailing wind at that level is in that direction. The upper air conditions at Northport, as stated by the United States Weather Bureau in 1929 (quoted in Canadian Document A 1, page 9) are as follows :

> The 5 a.m. balloon runs show the prevailing direction, since the Weather Bureau was established in Northport, to be northeast to an altitude of 600 metres above the surface. The average velocity, up to 600 metres level, is from 2 to 5 miles per hour. Above the 600 metres level the prevailing direction is southwest and gradually shifts into the west-southwest and west. The average velocities gradually increase from 5 miles per hour to about 30 miles per hour at the highest elevation, about 700 metres.

It thus appears that the velocity and persistence of the upper air currents is greater than that of the surface winds. The Tribunal is of opinion that the fumigations which occur at various points along the valley are caused by the mixing with the surface atmosphere of this upper air stream, of which the height has yet to be ascertained more fully. This mixing follows well-recognized meteorological laws and is controlled mainly by two factors of major importance. These are: (a) differences in temperature between the air near the surface and that at higher levels—in other words, the temperature gradient of the atmosphere of the region; and (b) differences in the velocity of the upper air currents and of those near the ground.

A careful study of the time, duration, and intensity of the fumigations recorded at the various stations down the valley reveals a number of striking and significant facts. The first of these is the coincidence in point of time of the fumigations. The most frequent fumigations in the late spring, summer, and early autumn are diurnal, and occur during the early morning hours. These usually are of short duration. A characteristic curve expressing graphically this type of fumigation, rises rapidly to a maximum and then falls less rapidly but fairly sharply to a concentration below the sensitivity of the recorder. The dominant influence here is evidently the heating action of the rising sun on the atmosphere at the surface of the earth. This gives rise to temperature differences which may and often do lead to a mixing of the gas-carrying atmosphere with that near the surface. When this occurs with sufficient intensity, a fumigation is recorded at all stations at which the sulphur dioxide reaches a concentration that is not too low to be determined by the recorder. Obviously this effect of the rising sun may be

different on the east and the west side of the valley, but the possible bearing of this upon fumigations in the valley must await further study.

Another type of fumigation occurs with especial frequency during the winter months. These fumigations are not so definitely diurnal in character and are usually of longer duration. The Tribunal is of the opinion that these are due to the existence for a considerable period of a sufficient velocity of the gas-carrying air current to cause a mixing of this with the surface atmosphere. Whether or not this mixing is of sufficient extent to produce a fumigation will depend upon the rate at which the surface air is diluted by surface winds which serve to bring in air from outside the contaminated area. The fact that fumigations of this type are more common during the night, when the surface winds often subside completely, bears out this opinion. A fumigation with a lower velocity of the gas-carrying air current would then be possible.

The conclusions above together with a detailed study of the intensity of the fumigations at the various stations from Columbia Gardens down the valley, have led to deductions in regard to the rate of attenuation of concentration of sulphur dioxide with increasing distance from the Smelter which seem to be in accord both with the known facts and the present theory. The conclusion of the Tribunal on this phase of the question is that the concentration of sulphur dioxide falls off very rapidly from Trail to a point about 16 miles downstream from the Smelter, or 6 miles from the boundary line, measured by the general course of the river; and that at distances beyond this point, the concentration of sulphur dioxide is lower and falls off more gradually and less rapidly.

The attention of the Tribunal has been called to the fact that fumigations in the area of probable damage sometimes occur during rainy weather or other periods of high atmospheric humidity. It is possible that this is more than a mere coincidence and that such weather conditions are, in general, more favorable to a fumigation, but the Tribunal is not prepared at present to offer an opinion on this subject.

The above conclusions have a bearing both upon the cause and upon the degree of damage as well as upon the area of probable damage.

The Tribunal will now proceed to consider the different classes of damage to cleared and to uncleared land.

(1) With regard to cleared land used for crops, the Tribunal has found that damage through reduction in crop yield due to fumigation has occurred in varying degrees during each of the years, 1932 to 1936; and it has found no proof of damage in the year 1937.

It has found that damage has been confined to an area which differed from year to year but which did not (with the possible exception of a very small number of farms in particularly unfavorable locations) exceed in the year of most extensive damage the following limits: the two precincts of Boundary and Northport, with the possible exclusion of some properties located at the eastern end of Boundary Precinct and at the western end of Northport Precinct; those parts of Cummins and Doyle Precincts on or close to the benches of the river; the part of Marble Precinct, north of the southern limit of Sections 22, 23 and 24 of T. 39, R. 39, and the part of Flat Creek Precinct, located on or close to the benches of the river (all precints being as defined by the United States Census of Agriculture of 1935).

The properties owned by individual farmers alleged by the United States to have suffered damage are divided by the United States in its itemized schedule of damages, into three classes: (a) properties of "farmers residing

on their farms"; (b) properties of "farmers who do not reside on their farms"; (ab) properties of "farmers who were driven from their farms"; (c) properties of large owners of land. The Tribunal has not adopted this division.

The Tribunal has adopted as the measure of indemnity to be applied on account of damage in respect of cleared land used for crops, the measure of damage which the American courts apply in cases of nuisance or trespass of the type here involved, *viz.*, the amount of reduction in the value of use or rental value of the land caused by the fumigations. In the case of farm land, such reduction in the value of the use is, in general, the amount of the reduction of the crop yield arising from injury to crops, less cost of marketing the same, the latter factor being under the circumstances of this case of negligible importance. (See Ralston *v.* United Verde Copper Co., 37 Federal Reporter 2d, 180, and 46 Federal Reporter 2d, 1.) Failure of farmers to increase their seeded land in proportion to such increase in other localities, may also be taken into consideration.

The difference between probable yield in the absence of any fumigation and actual crop yield, varying as it does from year to year and from place to place, is necessarily a somewhat uncertain amount, incapable of absolute proof; and the Tribunal has been obliged to base its estimate of damage largely on the fumigation records, meteorological data, statistical data as to crop yields inside and outside the area of probable damage, and other Census records.

As regards the problems arising out of abandonment of properties by their owners, it is to be noted that practically all of such properties, listed in the questionnaire sent out by the former Agent for the United States, Mr. Metzger, appear to have been abandoned prior to the year 1932. However, in order to deal both with this problem and with the problem arising out of failure of farmers to increase their seeded land, the Tribunal, not having to adjudicate on individual claims, estimated, on the basis of the statistical data available, the average acreage on which it is reasonable to say that crops would have been seeded and harvested during the period under consideration but for the fumigations.

As regards the special category of cleared lands used for orchards, the Tribunal is of opinion that no damage to orchards by sulphur dioxide fumigation within the damaged area during the years in question has been proved.

In addition to indemnity which may be awarded for damage through reduction in the value of the use of cleared land measured by decrease in crop yield, it may be contended that special damage has occurred for which indemnity should be awarded by reason of impairment of the soil contents through increased acidity caused by sulphur dioxide fumigations acting directly on the soil or indirectly through increased sulphur content of the streams and other waters. Evidence has been given in support of this contention. The Tribunal is of opinion that such injury to the soil up to this date, due to increased acidity and affecting harmfully the production of crops or otherwise, has not been proved—with one exception, as follows: There is a small area of farming property adjacent to the boundary, west of the river, that was injured by serious increase of acidity of soil due to fumigations. Such injury, though caused, in part, prior to January 1, 1932, may have produced a continuing condition which cannot be considered as a loss for a limited time—in other words, in this respect the nuisance may be considered to have a more permanent effect, in which case, under American law (*Sedgwick on Damages* 9th Ed. (1920) Sections 932, 947), the measure of damage was not the mere reduction in the value of the use of the land but

the reduction in the value of the land itself. The Tribunal is of opinion that such injury to the soil itself can be cured by artificial means, and it has awarded indemnity with this fact in view on the basis of the data available.

In addition to indemnity which may be awarded for damage through reduction in the value of the use of cleared land measured by decrease in crop yield, the Tribunal, having in mind, within the area as determined above, a group of about forty farms in the vicinity of the boundary line, has awarded indemnity for special damage for reduction in value of the use or rental value by reason of the location of the farmers in respect to the fumigations. (See Baltimore and Potomac R. R. *v.* Fifth Baptist Church (1883), 108 U.S. 317.)

The Tribunal is of opinion that there is no justification, under doctrines of American law, for assessing damages to improvements separately from the land in the manner contended for by the United States. Any injury to improvements (other than physical injury) is to be compensated in the award of indemnity for general reduction in the value of the use or rental value of the property.

There is a contention, however, that special damage has been sustained by some owners of improvements on cleared land, in the way of rust and destruction of metal work. There was some slight evidence of such damage, and the Tribunal has included indemnity therefor in its final award; but since there is an entire absence of any evidence as to the extent or monetary amount of such injury, the indemnity cannot be considered as more than a nominal amount for each of such owners.

(2) With respect to damage to cleared land not used for crops and to all uncleared (other than uncleared land used for timber), the Tribunal has adopted as the measure of indemnity, the measure of damages applied by American courts, *viz.*, the amount of reduction in the value of the use or rental value of the land. The Tribunal is of opinion that the basis of estimate of damages contended for by the United States, *viz.*, applying to the value of uncleared land a ratio of loss measured by the reduced crop yield on cleared land, has no sanction in any decisions of American courts.

(A) As regards these lands in their use as pasture lands, the Tribunal is of opinion that there is no evidence of any marked susceptibility of wild grasses to fumigations, and very little evidence to prove the respective amounts of uncleared land devoted to wild grazing grass and barren or shrub land, or to prove the value thereof, which would be necessary in order to estimate the value of the reduction of the use of such land. The Tribunal, however, has awarded a small indemnity for damage to about 200 acres of such lands in the immediate neighborhood of the boundary.

It has been contended that the death of trees and shrubs due to fumigation has had an injurious effect on the water storage capacity of the soil and has even created some soil erosion. The Tribunal is of opinion that while there may have been some erosion of soil and impairment of water storage capacity in a limited area near the boundary, it is impossible to determine whether such damage has been due to fires or to mortality of trees and shrubs caused by fumigation.

(B) As regards uncleared land in its use as timberland, the Tribunal has found that damage due to fumigation has occurred to trees during the years 1932 to 1937 inclusive, in varying degrees, over areas varying not only from year to year but also from species to species. It has not seemed feasible to give a determination of the geographical extent of the damage except in so far as it may be stated broadly, that a territory coinciding in extent with the

Bayle cruises (hereinafter described) may be considered as an average area, although the contours of the actually damaged area do not coincide for any given species in any given year with that area and the intensity of the damage in a given year and for a given species varies, of course, greatly, according to location.

In comparing the area covered by the Bayle cruises with the Hedgcock maps of injury to conifers for the years under consideration, the Tribunal is of opinion that damage near the boundary line has occurred in a somewhat broader area than that covered by the Bayle cruises, but that on the other hand, injury, except to larch in 1936, seems to have been confined below Marble to the immediate vicinity of the river.

It is evident that for many years prior to January 1, 1932, much of the forests in the area included in the present Northport and Boundary Precincts had been in a poor condition. West and east of the Columbia River, there had been the scene of a number of serious fires; and the operations of the Northport Smelting and Refining Company and its predecessor from 1898 to 1901, from 1901 to 1908, and from 1916 to 1921, had undoubtedly had an effect, as is apparent from the decisions in suits in the courts of the State of Washington on claims for damages from fumigations in this area [1]. It is uncontroverted that heavy fumigations from the Trail Smelter which destroyed and injured trees occurred in 1930 and 1931; and there were also serious fumigations in earlier years. In the Canadian Document A 1, termed "The Deans' Report", being a report made to the International Joint Commission in September, 1929, it is stated (pp. 29, 31):

> Since a cruise of the timber in the Northport area has not been made by a forest engineer of either Government, this report does not make any recommendations for settlements of timber damage. However, a brief statement as to the timber situation is submitted.
>
> *Present condition.* Practically the entire region was covered with timber when it was first settled. Probably 90 per cent of the merchantable timber has now been removed. The timber on about one-third of the area has been cut only in part, that is to say only the more valuable species have been logged, and on a large part of the rest of the area that has been cut-over are stands too small to cut at time of logging. These so-called residual stands, together with the remaining virgin timber, make up the timber resources of the Northport area at the present time. Heavy toll of these has been taken this season by two large forest fires still smouldering as this report is being written. . . . Government forest pathologists are working to determine the zone of economic injury to timber, but their task, a difficult one at best, is incomplete. Much additional data must be collected and after that all must be compiled and analyzed, hence no attempt is made to submit a map with this report delimiting the zone of injury to forest trees. Admittedly, however, serious damage to timber has already taken place and reproduction is impaired.

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[1] See Henry W. Sterrett *v.* Northport Smelting and Refining Co. (1902), 30 Washington Reports 164; Edwin J. Rowe *v.* Northport Smelting and Refining Co. (1904), 35 Washington Reports 101; Charles N. Park *v.* Northport Smelting and Refining Co. (1907), 47 Washington Reports 597; John O. Johnson *v.* Northport Smelting and Refining Co. (1908), 50 Washington Reports 507. These cases were not cited by counsel for either side.

"The Deans' Report" further mentioned a cruise of timber made by the Consolidated Mining and Smelting Co., in 1927 and 1928, "by a forest engineer from British Columbia", and that "it is our opinion that the timber estimate and evaluation are quite satisfactory. However, before settlements are made for such smoke damage, the work should be checked by a forest engineer, preferably of the American Government since it was first done by a Canadian. . . . It is believed, however, that a satisfactory check can be made by one man and an assistant in about three months. . . . The check cruise should be made not later than the summer of 1930."

It is to be further noted that in the official document of the State of Washington entitled *Forest Statistics, Stevens County, Washington, Forest Survey Release No.* 5, *A June*, 1937. *Progress Release*, there appears a map entitled *Forest Survey, Stevens County, Washington,* 1935, on which four types of forest lands are depicted by varied colorings and linings, and most of the lands in the area now in question are described as—"Principally Non-Restocked Old Burns and Cut-Overs; Rocky and Subalpine Areas" and "Principally Immature Forest—Recent Burns and Cut-Overs". And these terms are defined as follows (page 23): "Woodland—that portion of the forest land neither immediately or potentially productive of commercial timber. Included in this classification are: subalpine—stands above the altitude range of merchantability; rocky, non-commercial—area too steep, sterile, or rocky to produce merchantable timber." This description of timber as inaccessible, from the standpoint of logging, is further confirmed by the report made by G. J. Bayle (the forest engineer referred to in "The Deans' Report") of cruises made by him prior to 1932 (Canadian Document C 4, pp. 5,6) to the effect that much of the timber is "far away from transportation", "of very little, if any, commercial value", "sale price would not bring the cost of operating", "scattered", "located on steep slopes". On page 9 of the *Forest Survey Release No.* 5, above referred to, it is further stated:

> As a consequence of the recent serious fires principally in the north portion of the county, 52,402 acres of timberland have recently been deforested, many of which are restocking. Also concentrated in the north end of the county are 77,650 deforested acres representing approximately 6 per cent of the timberland area on which the possibilities of natural regeneration are slight. Much of this latter deforestation is thought to be the effect of alleged smelter fume damage.

(a) The Tribunal has adopted as the measure of indemnity, to be applied on account of damage in respect of uncleared land used for merchantable timber, the measure of damages applied by American courts, *viz.*, that since the destruction of merchantable timber will generally impair the value of the land itself, the measure of damage should be the reduction in the value of the land itself due to such destruction of timber; but under the leading American decisions, however, the value of the merchantable timber destroyed is, in general, deemed to be substantially the equivalent of the reduction in the value of the land (see *Sedgwick on Damages*, 9th Ed. 1920, Section 937a). The Tribunal is unable to accept the method contended for by the United States of estimating damage to uncleared timberland by applying to the value of such land as stated by the farmers (after deducting value of the timber) a ratio of loss measured by the reduced crop yield on cleared land. The Tribunal is of opinion, here as elsewhere in this decision, that, in accordance with American law, it is not restricted to the method proposed by the

United States in the determination of amount of damages, so long as its findings remain within the amount of the claim presented to it.

As, in estimating damage to timberland which occurred since January 1, 1932, it was essential to establish the amount of timber in existence on January 1, 1932, an unnecessarily difficult task has been placed upon the Tribunal, owing to the fact that the United States did not make a timber cruise in 1930 (as recommended by "The Deans' Report"); and neither the United States nor the Dominion of Canada caused any timber cruise to be made as of January 1, 1932. The cruises by witnesses supporting the claim of the United States in respect of lands owned by the State of Washington were made in 1927-1928 and in 1937. The cruises by Bayle (a witness for the Dominion of Canada) were made, partially in 1927-1928 and partially in 1936 and 1937. The affidavits of landowners filed by United States claimants in 1929 contain only figures for a date prior to such filing. Since the Bayle cruise of 1927-1928 appears to be the most detailed and comprehensive evidence of timber in the area of probable damage, the Tribunal has used it as a basis for estimate of the amount and value of timber existing January 1, 1932, after making due allowance for the heavy destruction of timber by fire, fumigation, insects, and otherwise, which occurred between the making of such cruise of 1927-1928 and January 1, 1932, and after making allowance for trees which became of merchantable size between said dates. The Tribunal has also used the Bayle cruises of 1936 and 1937 as a basis for estimates of the amount and value of timber existing on January 1, 1932.

(b) With regard to damage due to destruction and impairment of growing timber (not of merchantable size), the Tribunal has adopted the measure of damages applied by American courts, *viz.*, the reduction in value of the land itself due to such destruction and impairment. Growing timberland has a value for firewood, fences, etc., as well as a value as a source of future merchantable timber. No evidence has been presented by the United States as to the locations or as to the total amounts of such growing timber existing on January 1, 1932, or as to its distribution into types of conifers—yellow pine, Douglas fir, larch or other trees. While some destruction or impairment, deterioration, and retardation of such growing timber has undoubtedly occurred since such date, it is impossible to estimate with any degree of accuracy the amount of damage. The Tribunal has, however, taken such damage into consideration in awarding indemnity for damage to land containing growing timber.

(c) With respect to damage due to the alleged lack of reproduction, the Tribunal has carefully considered the contentions presented. The contention made by the United States that fumigation prevents germination of seed is, in the opinion of the Tribunal, not sustained by the evidence. Although the experiments were far from conclusive, Hedgcock's studies tend to show, on the contrary, that, while seedlings were injured after germination owing to drought or to fumes, the actual germination did take place.

With regard to the contention made by the United States of damage due to failure of trees to produce seed as a result of fumigation, the Tribunal is of opinion that it is not proved that fumigation prevents trees from producing sufficient seeds, except in so far as the parent-trees may be destroyed or deteriorated themselves. This view is confirmed by the Hedgcock studies on cone production of yellow pine. There is a rather striking correlation between the percentage of good, fair, and poor trees found in the Hedgcock Census studies and the percentages of trees bearing a normal amount of cones, trees bearing few cones, and trees bearing no cones in the Hedgcock cone

production studies. In so far, however, as lack of cone production since January 1, 1932, is due to death or impairment of the parent-trees occurring before that date, the Tribunal is of opinion that such failure of reproduction both was caused and occurred prior to January 1, 1932, with one possible exception as follows: From standard American writings on forestry, it appears that seeds of Douglas fir and yellow pine rarely germinate more than one year after they are shed [1], but if a tree was killed by fumigation in 1931, germination from its seeds might occur in 1932. It appears, however, that Douglas fir and yellow pine only produce a good crop of seeds once in a number of years. Hence, the Tribunal concludes that the loss of possible reproduction from seeds which might have been produced by trees destroyed by fumigation in 1931 is too speculative a matter to justify any award of indemnity.

It is fairly obvious from the evidence produced by both sides that there is a general lack of reproduction of both yellow pine and Douglas fir over a fairly large area, and this is certainly due to some extent to fumigations. But, with the data at hand, it is impossible to ascertain to what extent this lack of reproduction is due to fumigations or to other causes such as fires occurring repeatedly in the same area or destruction by logging of the cone-bearing trees. It is further impossible to ascertain to what extent lack of reproduction due to fumigations can be traced to mortality or deterioration of the parent-trees which occurred since the first of January, 1932. It may be stated, in general terms, that the loss of reproduction due to the forest being depleted will only become effective when the amount of these trees per acre falls below a certain minimum [2]. But the data at hand do not enable the Tribunal to say where and to what extent a depletion below this minimum occurred through fumigations in the years under consideration. An even approximate appraisal of the damage is further complicated by the fact that there is evidence of reproduction of lodgepole pine, cedar, and larch, even close to the boundary and in the Columbia River Valley, at least in some locations. This substitution may not be due entirely to fumigations, as it appears from standard American works on conifers that reproduction of yellow pine is often patchy; that when yellow pine is substantially destroyed in a given area, it is generally supplanted by another species of trees; and that lodgepole pine in particular has a tendency to invade and take full possession of yellow pine territory when a fire has occurred. While the other species are inferior, their reproduction is, nevertheless, a factor which has to be taken into account; but here again quantitative data are entirely lacking. It is further to be noted that the amount of rainfall is an important factor in the reproduction of yellow pine, and that where the normal annual rainfall is but little more than eighteen inches, yellow pine does not appear to thrive. It appears in evidence that the annual precipitation at Northport, in a period of fourteen years from 1923 to 1936, averaged slightly below seventeen inches. With all these considerations in mind, the

[1] See "Life of Douglas Fir Seed in the Forest Floor", by Leo A. Isaac, Journal of Forestry. Vol. 23 (1935), pp. 61-66; "The Pine Trees in the Rocky Mountain Region", by G. B. Sudworth, United States Department of Agriculture Bulletin (1917); "Timber Growing and Logging Practice in the Douglas Fir Region", by T. T. Munger and W. B. Greely, United States Department of Agriculture Technical Bulletin (1927). As to yellow pine and rainfall, see "Western Yellow Pine in Oregon", by T. T. Munger, United States Department of Agriculture Technical Bulletin (1917).

[2] Applied Silviculture in the United States, by R. H. Westveld (1935).

Tribunal has, however, taken lack of reproduction into account to some extent in awarding indemnity for damage to uncleared land in use for timber.

On the basis of the foregoing statements as to damage and as to indemnity for damage with respect to cleared land and uncleared land, the Tribunal has awarded with respect to damage to cleared land and to uncleared land (other than uncleared land used for timber), an indemnity of sixty-two thousand dollars ($62,000); and with respect to damage to uncleared land used for timber an indemnity of sixteen thousand dollars ($16,000) —being a total indemnity of seventy-eight thousand dollars ($78,000). Such indemnity is for the period from January 1, 1932, to October 1, 1937.

There remain for consideration three others items of damage claimed in the United States Statement: (Item c) "Damages in respect of livestock"; (Item d) "Damages in respect of property in the town of Northport"; (Item g) "Damages in respect of business enterprises".

(3) With regard to "damages in respect of livestock", claimed by the United States, the Tribunal is of opinion that the United States has failed to prove that the presence of fumes from the Trail Smelter has injured either the livestock or the milk or wool productivity of livestock since January 1, 1932, through impaired quality of crop or grazing. So far as the injury to livestock is due to reduced yield of crop or grazing, the injury to livestock is due to reduced yield of crop or grazing, the injury is compensated for in the indemnity which is awarded herein for such reduction of yield.

(4) With regard to "damages in respect of property in the town of Northport", the same principles of law apply to assessment of indemnity to owners of urban land as apply to owners of farm and other cleared land, namely, that the measure of damage is the reduction in the value of the use or rental value of the property, due to fumigations. The Tribunal is of opinion that there is no proof of damage to such urban property; that even if there were such damage, there is no proof of facts sufficient to enable the Tribunal to estimate the reduction in the value of the use or rental value of such property; and that it cannot adopt the method contended for by the United States of calculating damages to urban property.

(5) With regard to "damages in respect of business enterprises", the counsel for the United States in his Answer and Argument (p. 412) stated: "The business men unquestionably have suffered loss of business and impairment of the value of good will because of the reduced economic status of the residents of the damaged area." The Tribunal is of opinion that damage of this nature "due to reduced economic status" of residents in the area is too indirect, remote, and uncertain to be appraised and not such for which an indemnity can be awarded. None of the cases cited by counsel (pp. 412-423) sustain the proposition that indemnity can be obtained for an injury to or reduction in a man's business due to inability of his customers or clients to buy, which inability or impoverishment is caused by a nuisance. Such damage, even if proved, is too indirect and remote to become the basis, in law, for an award of indemnity. The Tribunal is also of opinion that if damage to business enterprises has occurred since January 1, 1932, the burden of proof that such damages was due to fumes from the Trail Smelter has not been sustained and that an award of indemnity would be purely speculative.

(6) The United States in its Statement (pp. 49-50) alleges the discharge by the Trail Smelter, not only of "smoke, sulphurous fumes, gases", but

also of "waste materials", and says that "the Trail Smelter disposes of slag in such a manner that it reaches the Columbia River and enters the United States in that stream", with the result that the "waters of the Columbia River in Stevens County are injuriously affected", thereby. No evidence was produced on which the Tribunal could base any findings as regards damage, if any, of this nature. The Dominion of Canada has contended that this item of damage was not within the meaning of the words "damage caused by the Trail Smelter", as used in Article III of the Convention. It would seem that this contention is based on the fact that the preamble of the Convention refers exclusively to a complaint of the Government of the United States to the Government of Canada "that fumes discharged from the Smelter .... have been causing damage in the State of Washington" (see Answer of Canada, p. 8). Upon this contention and its legal validity, the Tribunal does not feel that it is incumbent upon it to pass at the present time.

(7) The United States in its Statement (p. 52) presents two further items of damages claimed by it, as follows: (Item e) which the United States terms "damages in respect of the wrong done the United States in violation of sovereignty"; and (Item f) which the United States terms "damages in respect of interest on $350,000 eventually accepted in satisfaction of damage to January 1, 1932, but not paid until November 2, 1935".

With respect to (Item e), the Tribunal finds it unnecessary to decide whether the facts proven did or did not constitute an infringement or violation of sovereignty of the United States under international law independently of the Convention, for the following reason: By the Convention, the high contracting parties have submitted to this Tribunal the questions of the existence of damage caused by the Trail Smelter in the State of Washington, and of the indemnity to be paid therefor, and the Dominion of Canada has assumed under Article XII, such undertakings as will ensure due compliance with the decision of this Tribunal. The Tribunal finds that the only question to be decided on this point is the interpretation of the Convention itself. The United States in its Statement (p. 59) itemizes under the claim of damage for "violation of sovereignty" only money expended "for the investigation undertaken by the United States Government of the problems created in the United States by the operation of the Smelter at Trail". The Tribunal is of opinion that it was not within the intention of the parties, as expressed in the words "damage caused by the Trail Smelter" in Article III of the Convention, to include such moneys expended. This interpretation is confirmed by a consideration of the proceedings and of the diplomatic correspondence leading up to the making of the Convention. Since the United States has not specified any other damage based on an alleged violation of its sovereignty, the Tribunal does not feel that it is incumbent upon it to decide whether, in law and in fact, indemnity for such damage could have been awarded if specifically alleged. Certainly, the present controversy does not involve any such type of facts as the persons appointed under the Convention of January 23, 1934, between the United States of America and the Dominion of Canada felt to justify them in awarding to Canada damages for violation of sovereignty in the *I'm Alone* award of January 5, 1935. And in other cases of international arbitration cited by the United States, damages awarded for expenses were awarded, not as compensation

for violation of national sovereignty, but as compensation for expenses incurred by individual claimants in prosecuting their claims for wrongful acts by the offending Government.

In his oral argument, the Agent for the United States, Mr. Sherley, claimed repayment of the aforesaid expenses of investigations on a further and separate ground, *viz.*, as an incident to damages, saying (Transcript, p. 5157): "Costs and interest are incident to the damage, the proof of the damage which occurs through a given act complained of", and again (Transcript, p. 5158): "The point is this, that it goes as an incident to the award of damage." The Tribunal is unable to accept this view. While in cases involving merely the question of damage to individual claimants, it may be appropriate for an international tribunal to award costs and expenses as an incident to other damages proven (see cases cited by the Agent for the United States in the Answer and Argument, pp. 431, 437, 453-465, and at the oral argument in Transcript, p. 5153), the Tribunal is of opinion that such costs and expenses should not be allowed in a case of arbitration and final settlement of a long pending controversy between two independent Governments, such as this case, where each Government has incurred expenses and where it is to the mutual advantage of the two Governments that a just conclusion and permanent disposition of an international controversy should be reached.

The Agent for the United States also cited cases of litigation in courts of the United States (Answer and Argument, p. 439, and Transcript, p. 5152), in which expenses incurred were ordered by the court to be paid. Such cases, the Tribunal is of opinion, are inapplicable here.

The Tribunal is, therefore, of opinion that neither as a separable item of damage nor as an incident to other damages should any award be made for that which the United States terms "violation of sovereignty".

(8) With respect to (Item f), "damages in respect of interest on $350,000 eventually accepted in satisfaction of damage to January 1, 1932, but not paid until November 2, 1935", the Tribunal is of opinion that no payment of such interest was contemplated by the Convention and that by payment within the term provided by Article I thereof, the Dominion of Canada has completely fulfilled all obligations with respect to the payment of the sum of $350,000. Hence, such interest cannot be allowed.

In conclusion, the Tribunal answers Question 1 in Article III, as follows: Damage caused by the Trail Smelter in the State of Washington has occurred since the first day of January, 1932, and up to October 1, 1937, and the indemnity to be paid therefor is seventy-eight thousand dollars ($78,000), and is to be complete and final indemnity and compensation for all damage which occurred between such dates. Interest at the rate of six per centum per year will be allowed on the above sum of seventy-eight thousand dollars ($78,000) from the date of the filing of this report and decision until date of payment. This decision is not subject to alteration or modification by the Tribunal hereafter.

The fact of existence of damage, if any, occurring after October 1, 1937, and the indemnity to be paid therefor, if any, the Tribunal will determine in its final decision.

PART THREE.

As to Question No. 2, in Article III of the Convention, which is as follows:

(2) In the event of the answer to the first part of the preceding question being in the affirmative, whether the Trail Smelter should be required to refrain from causing damage in the State of Washington in the future and, if so, to what extent?

the Tribunal decides that until the date of the final decision provided for in Part Four of this present decision, the Trail Smelter shall refrain from causing damage in the State of Washington in the future to the extent set forth in such Part Four until October 1, 1940, and thereafter to such extent as the Tribunal shall require in the final decision provided for in Part Four.

PART FOUR.

As to Question No. 3, in Article III of the Convention, which is as follows:

(3) In the light of the answer to the preceding question, what measures or régime, if any, should be adopted or maintained by the Trail Smelter?

the Tribunal is unable at the present time, with the information that has been placed before it, to determine upon a permanent régime, for the operation of the Trail Smelter. On the other hand, in view of the conclusions at which the Tribunal has arrived (as stated in an earlier part of this decision) with respect to the nature, the cause, and the course of the fumigations, and in view of the mass of data relative to sulphur emissions at the Trail Smelter, and relative to meteorological conditions and fumigations at various points down the Columbia River Valley, the Tribunal feels that the information now available does enable it to predict, with some degree of assurance, that a permanent régime based on a more adequate and intensive study and knowledge of meteorological conditions in the valley, and an extension and improvement of the methods of operation of the plant and its control in closer relation to such meteorological conditions, will effectively prevent future significant fumigations in the United States, without unreasonably restricting the output of the plant.

To enable it to establish a permanent régime based on the more adequate and intensive study and knowledge above referred to, the Tribunal establishes the following temporary régime.

(1) For the purpose of administering an experimental period, to continue to a date not later than October 1, 1940, the Tribunal will appoint two Technical Consultants, and in case of vacancy will appoint the successor. Such Technical Consultants to be appointed in the first place shall be Reginald S. Dean and Robert E. Swain, and they shall cease to act as Advisers to the Tribunal under the Convention during such trial period.

(2) The Tribunal directs that, before May 1, 1938, a consulting meteorologist, adequately trained in the installation and operation of the necessary type of equipment, be employed by the Trail Smelter, the appointment to be subject to the approval of the Technical Consultants. The Tribunal directs that, beginning May 1, 1938, such meteorological observations as may be deemed necessary by the Technical Consultants shall be made, under

their direction, by the meteorologist, the scientific staff of the Trail Smelter, or otherwise. The purpose of such observations shall be to determine, by means of captive balloons and otherwise, the weather conditions and the height, velocity, temperature, and other characteristics of the gas-carrying and other air currents and of the gas emissions from the stacks.

(3) The Tribunal further directs that beginning May 1, 1938, there shall be installed and put in operation and maintained by the Trail Smelter, for the purpose of providing information which can be used in determining present and prospective wind and other atmospheric conditions, and in making a prompt application of those observations to the control of the Trail Smelter plant operation:

(a) Such observation stations as the Technical Consultants deem necessary.

(b) Such equipment at the stacks as the Technical Consultants may find necessary to give adequate information of gas conditions and in connection with the stacks and stack effluents.

(c) Sulphur dioxide recorders, stationary and portable (the stationary recorders not to exceed three in number).

(d) The Technical Consultants shall have the direction of and authority over the location in both the United States and the Dominion of Canada, and over the installation, maintenance and operation of all apparatus provided for in Paragraph 2 and Paragraph 3. They may require from the meteorologist and from the Trail Smelter regular reports as to the operation of all such apparatus.

(e) The Technical Consultants may require regular reports from the Trail Smelter as to the methods of operation of its plant in such form and at such times as they shall direct; and the Trail Smelter shall conduct its smelting operations in conformity with the directions of the Technical Consultants and of the Tribunal, based on the result of the data obtained during the period hereinafter named; and the Technical Consultants and the Tribunal may change or modify at any time its or their instructions as to such operations.

(f) It is the intent and purpose of the Tribunal that the administration of the observations, experiments, and operations above provided for shall be as flexible as possible, and subject to change or modification by the Technical Consultants and by the Tribunal, to the end that conditions as they at any time may exist, may be changed as circumstances require.

(4) The Technical Consultants shall make report to the Tribunal at such dates and in such manner as it shall prescribe as to the results obtained and conclusions formed from the observations, experiments, and operations above provided for.

(5) The observations, experiments, and operations above provided for shall continue on a trial basis through the remainder of the crop-growing season of 1938, the crop-growing seasons of 1939 and 1940, and the winter seasons of 1938-1939 and 1939-1940 and until October 1, 1940, unless the Tribunal shall find it practicable or necessary to terminate such trial period at an earlier date.

(6) At the end of the trial period above provided for, or at the end of such shorter trial period as the Tribunal may find to be practicable or necessary, the Tribunal in a final decision will determine upon a permanent régime and upon the indemnity and compensation, if any, to be paid under the Convention. Such final decision, under the agreements for extension,

heretofore entered into by the two Governments under Article XI of the Convention, shall be reported to the Governments within three months after the date of the end of the trial period.

(7) The Tribunal shall meet at least once in the year 1939, to consider reports and to take such action as it may deem necessary.

(8) In case of disagreement between the Technical Consultants, they shall refer the matter to the Tribunal for its decision, and all persons and the Trail Smelter affected hereunder shall act in conformity with such decision.

(9) In order to lessen, as far as possible, the fumigations during the interval of time extending from May 1, 1938, to October 1, 1938 (during which time or during part of which time, it is possible that the observations and experiments above provided for may not be in full operation), the Tribunal directs that the Trail Smelter shall be operated with the following limitations on the sulphur emissions—it being understood that the Tribunal is not at present ready to make such limitations permanent, but feels that they will for the present probably reduce the chance or possibility of injury in the area of probable damage.

(a) For the periods April 25 to May 10 and June 22 to July 6, which are periods of greater sensitivity to sulphur dioxide for certain crops and trees in that area, not more than 100 tons per day of sulphur shall be emitted from the stacks of the Trail Smelter.

(b) As a further precaution, and for the entire period until October 1, 1938, the sulphur dioxide recorder at Columbia Gardens and the sulphur dioxide recorder at the Stroh farm (or any other point approved by the Technical Consultants) shall be continuously operated, and observations of relative humidity shall also be taken at both recorder stations. When, between the hours of sunrise and sunset, the sulphur dioxide concentration at Columbia Gardens exceeds one part per million for three consecutive 20-minute periods, and the relative humidity is 60 per cent or higher, the Trail Smelter shall be notified immediately; and the sulphur emission from the stacks of the plant maintained at 5 tons of sulphur per hour or less until the sulphur dioxide concentration at the Columbia Gardens recorder station falls to 0.5 part per million.

(c) This regulation may be suspended temporarily at any time by order of the Technical Consultants or of the Tribunal, if in its operation it shall interfere with any particular program of investigation which is in progress.

(10) For the carrying out of the temporary régime herein prescribed by the Tribunal, the Dominion of Canada shall undertake to provide for the payment of the following expenses thereof: (a) the Tribunal will fix the compensation of the Technical Consultants and of such clerical or other assistants as it may find necessary to employ; (b) statements of account shall be rendered by the Technical Consultants to the Tribunal and approved by the Chairman in writing; (c) the Dominion of Canada shall deposit to the credit of the Tribunal from time to time in a financial institution to be designated by the Chairman of the Tribunal, such sums as the Tribunal may find to be necessary for the payment of the compensation, travel, and other expenses of the Technical Consultants and of the clerical or other assistants; (d) written report will be made by the Tribunal to the Dominion of Canada of all the sums received and expended by it, and any sum not expended shall be refunded by the Tribunal to the Dominion of Canada at the conclusion of the trial period.

(11) The terms "Tribunal", and "Chairman", as used herein, shall be deemed to mean the Tribunal, and the Chairman, as it or they respectively may be constituted at any future time under the Convention.

The term "Trail Smelter", as used herein, shall be deemed to mean the Consolidated Mining and Smelting Company of Canada, Limited, or its successors and assigns.

Nothing in the above paragraphs of Part Four of this decision shall relieve the Dominion of Canada from any obligation now existing under the Convention with reference to indemnity or compensation, if any, which the Tribunal may find to be due for damage, if any, occurring during the period from October 1, 1937 (the date to which indemnity for damage is now awarded) to October 1, 1940, or to such earlier date at which the Tribunal may render its final decision.

(*Signed*)
JAN HOSTIE.

(*Signed*)
CHARLES WARREN.

(*Signed*)
R. A. E. GREENSHIELDS.

DECISION

REPORTED ON MARCH 11, 1941, TO THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND TO THE GOVERNMENT OF THE DOMINION OF CANADA, UNDER THE CONVENTION SIGNED APRIL 15, 1935.

This Tribunal is constituted under, and its powers are derived from and limited by, the Convention between the United States of America and the Dominion of Canada signed at Ottawa, April, 15, 1935, duly ratified by the two parties, and ratifications exchanged at Ottawa, August 3, 1935 (hereinafter termed "the Convention").

By Article II of the Convention, each Government was to choose one member of the Tribunal and the two Governments were to choose jointly a chairman who should be neither a British subject nor a citizen of the United States. The members of the Tribunal were chosen as follows: by the United States of America, Charles Warren of Massachusetts; by the Dominion of Canada, Robert A.E. Greenshields of the Province of Quebec; by the two Governments jointly, Jan Frans Hostie of Belgium.

Article II, paragraph 4, of the Convention provided that "the Governments may each designate a scientist to assist the Tribunal"; and scientists were designated as follows: by the United States of America, Reginald S. Dean of Missouri; and by the Dominion of Canada, Robert E. Swain of California. In November, 1940, Victor H. Gottschalk of Washington, D.C., was designated by the United States as alternate to Reginald S. Dean. The Tribunal desires to record its appreciation of the valuable assistance received by it from these scientists.

The Tribunal herewith reports its final decisions.

The controversy is between two Governments involving damage occurring, or having occurred, in the territory of one of them (the United States of America) and alleged to be due to an agency situated in the territory of the other (the Dominion of Canada). In this controversy, the Tribunal did not sit and is not sitting to pass upon claims presented by individuals or on behalf of one or more individuals by their Government, although individuals may come within the meaning of "parties concerned", in Article IV and of "interested parties", in Article VIII of the Convention and although the damage suffered by individuals did, in part, "afford a convenient scale for the calculation of the reparation due to the State" (see Judgment No. 13, Permanent Court of International Justice, Series A, No. 17, pp. 27, 28). (*Cf.* what was said by the Tribunal in the decision reported on April 16, 1938, as regards the problems arising out of abandonment of properties, Part Two, Clause (1).)

As between the two countries involved, each has an equal interest that if a nuisance is proved, the indemnity to damaged parties for proven damage shall be just and adequate and each has also an equal interest that unproven or unwarranted claims shall not be allowed. For, while the United States' interests may now be claimed to be injured by the operations of a Canadian corporation, it is equally possible that at some time in the future Canadian

interests might be claimed to be injured by an American corporation. As has well been said: "It would not be to the advantage of the two countries concerned that industrial effort should be prevented by exaggerating the interests of the agricultural community. Equally, it would not be to the advantage of the two countries that the agricultural community should be oppressed to advance the interest of industry."

Considerations like the above are reflected in the provisions of the Convention in Article IV, that "the desire of the high contracting parties" is "to reach a solution just to all parties concerned". And the phraseology of the questions submitted to the Tribunal clearly evinces a desire and an intention that, to some extent, in making its answers to the questions, the Tribunal should endeavor to adjust the conflicting interests by some "just solution" which would allow the continuance of the operation of the Trail Smelter but under such restrictions and limitations as would, as far as foreseeable, prevent damage in the United States, and as would enable indemnity to be obtained, if in spite of such restrictions and limitations, damage should occur in the future in the United States.

In arriving at its decision, the Tribunal has had always to bear in mind the further fact that in the preamble to the Convention, it is stated that it is concluded with the recognition of "the desirability and necessity of effecting a permanent settlement".

The duty imposed upon the Tribunal by the Convention was to "finally decide" the following questions:

(1) Whether damage caused by the Trail Smelter in the State of Washington has occurred since the first day of January, 1932, and, if so, what indemnity should be paid therefor?

(2) In the event of the answer to the first part of the preceding question being in the affirmative, whether the Trail Smelter should be required to refrain from causing damage in the State of Washington in the future and, if so, to what extent?

(3) In the light of the answer to the preceding question, what measures or régime, if any, should be adopted or maintained by the Trail Smelter?

(4) What indemnity or compensation, if any, should be paid on account of any decision or decisions rendered by the Tribunal pursuant to the next two preceding questions?

The Tribunal met in Washington, in the District of Columbia, on June 21, 22, 1937, for organization, adoption of rules of procedure and hearing of preliminary statements. From July 1 to July 6, it travelled over and inspected the area involved in the controversy in the northern part of Stevens County in the State of Washington and it also inspected the smelter plant of the Consolidated Mining and Smelting Company of Canada, Limited, at Trail in British Columbia. It held sessions for the reception and consideration of such evidence, oral and documentary, as was presented by the Governments or by interested parties, as provided in Article VIII, in Spokane in the State of Washington, from July 7 to July 29, 1937; in Washington, in the district of Columbia, on August 16, 17, 18, 19, 1937; in Ottawa, in the Province of Ontario, from August 23 to September 18, 1937; and it heard arguments of counsel in Ottawa from October 12 to October 19, 1937.

On January 2, 1938, the Agents of the two Governments jointly informed the Tribunal that they had nothing additional to present. Under the provisions of Article XI of the Convention, it then became the duty of the

Tribunal "to report to the Governments its final decisions . . . . within a period of three months after the conclusion of the proceedings", *i.e.* on April 2, 1938.

After long consideration of the voluminous typewritten and printed record and of the transcript of evidence presented at the hearings, the Tribunal formally notified the Agents of two the Governments that, in its opinion, unless the time limit should be extended, the Tribunal would be forced to give a permanent decision on April 2, 1938, on the basis of data which it considered inadequate and unsatisfactory. Acting on the recommendation of the Tribunal and under the provisions of Article XI authorizing such extension, the two Governments by agreement extended the time for the report of final decision of the Tribunal to three months from October 1, 1940.

On April 16, 1938, the Tribunal reported its "final decision" on Question No. 1, as well as its temporary decisions on Questions No. 2 and No. 3, and provided for a temporary régime thereunder. The decision reported on April 16, 1938, will be referred to hereinafter as the "previous decision".

Concerning Question No. 1, in the statement presented by the Agent for the Government of the United States, claims for damages of $1,849,156.16 with interest of $250,855.01—total $2,100,011.17—were presented, divided into seven categories, in respect of (*a*) cleared land and improvements; (*b*) of uncleared land and improvements; (*c*) live stock; (*d*) property in the town of Northport; (*e*) wrong done the United States in violation of sovereignty, measured by cost of investigation from January 1, 1932, to June 30, 1936; (*f*) interest on $350,000 accepted in satisfaction of damage to January 1, 1932, but not paid on that date; (*g*) business enterprises. The area claimed to be damaged contained "more than 140,000 acres", including the town of Northport.

The Tribunal disallowed the claims of the United States with reference to items (*c*), (*d*), (*e*), (*f*) and (*g*) but allowed them, in part, with respect to the remaining items (*a*) and (*b*).

In conclusion (end of Part Two of the previous decision), the Tribunal answered Question No. 1 as follows:

> Damage caused by the Trail Smelter in the State of Washington has occurred since the first day of January, 1932, and up to October 1, 1937, and the indemnity to be paid therefor is seventy-eight thousand dollars ($78,000), and is to be complete and final indemnity and compensation for all damage which occurred between such dates. Interest at the rate of six per centum per year will be allowed on the above sum of seventy-eight thousand dollars ($78,000) from the date of the filing of this report and decision until date of payment. This decision is not subject to alteration or modification by the Tribunal hereafter. The fact of existence of damage, if any, occurring after October 1, 1937, and the indemnity to be paid therefor, if any, the Tribunal will determine in its final decision

Answering Questions No. 2 and No. 3, the Tribunal decided that, until a final decision should be made, the Trail Smelter should be subject to a temporary régime (described more in detail in Part Four of the present decision) and a trial period was established to a date not later than October 1, 1940, in order to enable the Tribunal to establish a permanent régime based on a "more adequate and intensive study", since the Tribunal felt that the information that had been placed before it did not enable it to determine at that time with sufficient certainty upon a permanent régime.

In order to supervise the conduct of the temporary régime and in accordance with Part Four, Clause (1) of the previous decision, the Tribunal appointed two Technical Consultants, Dr. R. S. Dean and Professor R. E. Swain. As further provided in said Part Four (Clause 7), the Tribunal met at Washington, D.C., with these Technical Consultants from April 24, 1939, to May 1, 1939, to consider reports of the latter and determine the further course to be followed during the trial period (see Part Four of the present decision).

It had been provided in the previous decision that a final decision on the outstanding questions would be rendered within three months from the termination of the trial period therein prescribed, *i.e.*, from October 1, 1940, unless the trial period was ended sooner. The trial period was not terminated before October 1, 1940. As the Tribunal deemed it necessary after the intervening period of two and a half years to receive supplementary statements from the Governments and to hear counsel again before determining upon a permanent régime, a hearing was set for October 1, 1940. Owing, however, to disruption of postal communications and other circumstances, the supplementary statement of the United States was not transmitted to the Dominion of Canada until September 25, 1940, and the public meeting was, in consequence, postponed.

The Tribunal met at Boston, Massachusetts, on September 26 and 27, 1940, for adoption of additional rules of procedure. It met at Montreal, P.Q., with its scientific advisers, from December 5 to December 8, 1940, to consider the Final Report they had rendered in their capacity as Technical Consultants (see Part Four of this decision). It held its public meeting and heard arguments of counsel in Montreal, from December 9 to December 12, 1940.

The period within which the Tribunal shall report its final decisions was extended by agreement of the two Governments until March 12, 1941.

I.

By way of introduction to the Tribunal's decision, a brief statement, in general terms, of the topographic and climatic conditions and economic history of the locality involved in the controversy may be useful.

The Columbia River has its source in the Dominion of Canada. At a place in British Columbia named Trail, it flows past a smelter located in a gorge, where zinc and lead are smelted in large quantities. From Trail, its course is easterly and then it swings in a long curve to the international boundary line, at which point it is running in a southwesterly direction; and its course south of the boundary continues in that general direction. The distance from Trail to the boundary line is about seven miles as the crow flies or about eleven miles, following the course of the river (and possibly a slightly shorter distance by following the contour of the valley). At Trail and continuing down to the boundary and for a considerable distance below the boundary, mountains rise on either side of the river in slopes of various angles to heights ranging from 3,000 to 4,500 feet above sea-level, or between 1,500 to 3,000 feet above the river. The width of the valley proper is between one and two miles. On both sides of the river are a series of bench lands at various heights.

More or less half way between Trail and the boundary is a place, on the east side of the river, known as Columbia Gardens; at the boundary, on the east side of the river and on the south side of its affluent, the Pend-d'Oreille,

are two places respectively known as Waneta and Boundary; the former is on the Canadian side of the boundary, the latter on the American side; four or five miles south of the boundary, and on the west side of the river, is a farm, named after its owner, Fowler Farm (Section 22, T. 40, R. 40), and on the east side of the river, another farm, Stroh Farm, about five miles south of the boundary.

The town of Northport is located on the east bank of the river, about nineteen miles from Trail by the river, and about thirteen miles as the crow flies. It is to be noted that mountains extending more or less in an easterly and westerly direction rise to the south between Trail and the boundary.

Various creeks are tributary to the river in the region of Northport, as follows: Deep Creek flowing from southeast to northwest and entering the river slightly north of Northport; opposite Deep Creek and entering on the west side of the river and flowing from the northwest, Sheep Creek; north of Sheep Creek on the west side, Nigger Creek; south of Sheep Creek on the west side, Squaw Creek; south of Northport, on the east side, flowing from the southeast, Onion Creek.

About eight miles south of Northport, following the river, is the town of Marble; and about seventeen miles, the town of Bossburg. Three miles south of Bossburg is the town of Evans; and about nine miles, the town of Marcus. South of Marcus and about forty-one miles from the boundary line is the town of Kettle Falls which, in general, may be stated to be the southern limit of the area as to which evidence was presented. All the above towns are small in population and in area.

At Marble and to the south, various other creeks enter the river from the west side--Rattlesnake Creek, Crown Creek, Flat Creek, and Fifteen Mile Creek.

Up all the creeks above mentioned, there extend tributary valleys, differing in size.

While, as stated above, the width of the valley proper of the river is from one to two miles, the width of the valley measured at an altitude of 3,000 feet above sea-level, is approximately three miles at Trail, two and one-half miles at Boundary, four miles above Northport, three and one-half miles at Marble. Near Bossburg and southward, the valley at the same altitude broadens out considerably.

As to climatic conditions, it may be stated that the region is, in general, a dry one though not what is termed "arid". The average annual precipitation at Northport from 1923 to 1940 inclusive averaged somewhat above seventeen inches. It varied from a minimum of 9.60 inches in 1929 to a maximum of 26.04 inches in 1927. The rainfall in the growing-season months of April, May and June at Northport, has been in 1938, 2.30 inches; in 1939, 3.78 inches, and in 1940, 3.24 inches. The average humidity varies with some regularity from day to day. In June, 1937, at Northport, it had an average maximum of 74% at 5 a.m. and an average minimum of 26% at 5 p.m.

The range of temperature in the different months as it appears from the records of the years 1934 to 1940 inclusive, at Northport was as follows: in the months of November, December, January and February, the lowest temperature was -19° (in January, 1937), and the highest was 60° (in November, 1934); in the growing-season months of April, May, June and July, the lowest temperature was 12° (in April, 1936), and the highest was 110° (in July, 1934); in the remaining months of August, September, October and March, the lowest temperature was 8° (in October, 1935 and March, 1939), and the highest was 104° (in September, 1938).

The direction of the surface wind is, in general, from the northeast down the river valley, but this varies at different times of day and in different seasons. The subject of winds is further treated in Part Four of this decision and, in detail, in the Final Report of the Technical Consultants.

The history of what may be termed the economic development of the area may be briefly stated as follows: Previous to 1892, there were few settlers in this area, but homesteading and location of farms received an impetus, particularly on the east side of the river, at the time when the construction of the Spokane and Northern Railway was undertaken, which was completed between the City of Spokane and Northport in 1892, and extended to Nelson in British Columbia in 1893. In 1892, the town of Northport was founded. In 1900, the population of this town was 787. It fell in 1910 to 476 but rose again, in 1920, to 906. In 1930, it had fallen to 391. The population of the precincts nearest the boundary line, *viz.*, Boundary and Northport (including Frontier and Nigger Creek Precincts prior to 1931) was 919 in 1900; 913 in 1910; 1,304 in 1920; 648 in 1930 and 651 in 1940. In these precincts, the area of all land in farms in 1925 was 5,292 acres; in 1930, 8,040 acres; in 1935, 5,666 acres and in 1940, 7,175 acres. The area in crop-land in 1925 was 798 acres; in 1930, 1,227 acres; in 1935, 963 acres and in 1940, about 900 acres[1]. In two other precincts east of the river and south of the boundary, Cummins and Doyle, the population in 1940 was 293, the area in farms was 6,884 acres and the area in crop-land was about 1,738 acres [2].

About the year 1896, there was established in Northport a business which has been termed the "Breen Copper Smelter", operated by the LeRoi Mining and Smelting Company, and later carried on by the Northport Smelting and Refining Company which was chartered in 1901. This business employed at times from five hundred to seven hundred men, although as compared with a modern smelter like the Trail Smelter, the extent of its operations was small. The principal value of the ores smelted by it was in copper, and the ores had a high sulphur content. For some years, the somewhat primitive method of "heap roasting" was employed which consisted of roasting the ore in open piles over woodfires, frequently called in mining parlance, "stink piles". Later, this process was changed. About seventy tons of sulphur were released per day. This Northport Smelting and Refining Company intermittently continued operations until 1908. From 1908 until 1915, its smelter lay idle. In March, 1916, operation was resumed for the purpose of smelting lead ore, and continued until March 5, 1921, when it ceased business and its plant was dismantled. About 30 tons of sulphur per day were emitted during this time. There is no doubt that damage was caused to some extent over a more or less restricted area by the operation of this smelter plant.

In addition to the smelting business, there have been intermittent mining operations of lead and zinc in this locality, but they have not been a large factor in adding to the population.

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[1] For the Precinct of Boundary, the acreage of crop-land, idle or fallow, was omitted from the reports received by the Tribunal of the 1940 Census figures, the statement being made that it was "omitted to avoid disclosure of individual operations".

[2] For the Precinct of Cummins, the acreage of crop failure and of crop-land, idle or fallow, is only approximately correct, the census figures making similar omissions and for the same reason.

The most important industry in the area formerly was the lumber industry. It had its beginning with the building of the Spokane and Northern Railway. Several saw mills were constructed and operated, largely for the purpose of furnishing ties to the railway. In fact, the growing trees—yellow pine, Douglas fir, larch, and cedar—were the most valuable asset to be transformed into ready cash. In early days, the area was rather heavily wooded, but the timber has largely disappeared and the lumber business is now of small size. On about 57,000 acres on which timber cruises were made in 1927-1928 and in 1936 in the general area, it may be doubtful whether there is today more than 40,000 thousands of board feet of merchantable timber.

As to agricultural conditions, it may be said that farming is carried on in the valley and upon the benches and mountain slopes and in the tributary valleys. The soils are of a light, sandy nature, relatively low in organic matter, although in the tributary valleys the soil is more loamy and fertile. In some localities, particularly on the slopes, natural sub-irrigation affords sufficient moisture; but in other regions irrigation is desirable in order to produce favorable results. In a report made by Dr. F. C. Wyatt, head of the Soils Department of the University of Alberta, in 1929, it is stated that "taken as a unit, the crop range of these soils is wide and embraces the crops suited to the climate conditions. Under good cultural operations, yields are good." At the same time, it must be noted that a large portion of this area is not primarily suited to agriculture. In a report of the United States Department of Agriculture, in 1913, it is stated that "there is approximately one-third of the land in the Upper Columbia Basin unsuited for agricultural purposes, either because it is too stony, too rough, too steep, or a combination of these factors. To utilize this large proportion of land and to meet the wood needs of an increasing population, the Upper Columbia Basin is forced to consider seriously the problem of reforestation and conservation." Much of the farming land, especially on the benches, is land cleared from forest growth; most of the farms contain from an eighth to a quarter of a section (80-160 acres); and there are many smaller and some larger farms.

In general, the crops grown on the farms are alfalfa, timothy, clover, grain cut green for hay, barley, oats, wheat, and a small amount of potatoes. Wild hay is cut each year to some extent. The crops, in general, are grown for feed rather than for sale, though there is a certain amount of wheat and oats sold. Much of the soil is apparently well suited to the predominant crop of alfalfa, which is usually cut at present twice a year(with a small third crop on some farms). Much of the present alfalfa has been rooted for a number of years.

Milch cattle are raised to a certain extent and they are grazed on the wild grasses on the hills and mountains in the summer months, but the dairying business depends on existence of sufficient land under cultivation as an adjunct to the dairy to provide adequate forage for the winter months.

In early days, it was believed that, owing to soil and climatic conditions, this locality was destined to become a fruit-growing region, and a few orchards were planted. For several reasons, of which it is claimed that fumigation is one, orchards have not thrived. In 1909-1910, the Upper Columbia Company purchased two large tracts, comprising about ten thousand acres, with the intention of developing the land for orchard purposes and selling of timber in the meantime, and it established a large orchard of about 900 acres in the town of Marble. The project, as early 1917, proved a failure.

II.

In 1896, a smelter was started under American auspices near the locality known as Trail, B.C. In 1906, the Consolidated Mining and Smelting Company of Canada, Limited, obtained a charter of incorporation from the Canadian authorities, and that company acquired the smelter plant at Trail as it then existed. Since that time, the Canadian company, without interruption, has operated the Smelter, and from time to time has greatly added to the plant until it has become one of the best and largest equipped smelting plants on the American continent. In 1925 and 1927, two stacks of the plant were erected to 409 feet in height and the Smelter greatly increased its daily smelting of zinc and lead ores. This increased production resulted in more sulphur dioxide fumes and higher concentrations being emitted into the air. In 1916, about 5,000 tons of sulphur per month were emitted; in 1924, about 4,700 tons; in 1926, about 9,000 tons—an amount which rose near to 10,000 tons per month in 1930. In other words, about 300-350 tons of sulphur were being emitted daily in 1930. (It is to be noted that one ton of sulphur is substantially the equivalent of two tons of sulphur dioxide or SO_2.)

From 1925, at least, to 1937, damage occurred in the State of Washington, resulting from the sulphur dioxide emitted from the Trail Smelter as stated in the previous decision.

The subject of fumigations and damage claimed to result from them was referred by the two Governments on August 7, 1928, to the International Joint Commission, United States and Canada, under Article IX of the Convention of January 11, 1909, between the United States and Great Britain, providing that the high contracting parties might agree that "any other question or matters of difference arising between them involving the rights, obligations or interests of either in relation to the other, or to the inhabitants of the other, along the common frontier between the United States and the Dominion of Canada shall be referred from time to time to the International Joint Commission for examination and report. Such reports shall not be regarded as decisions of the question or matters so submitted either on the facts or on the law, and shall not, in any way, have the character of an arbitral award."

The questions referred to the International Joint Commission were five in number, the first two of which may be noted: first, the extent to which property in the State of Washington has been damaged by fumes from the Smelter at Trail B.C.; second, the amount of indemnity which would compensate United States' interests in the State of Washington for past damages.

The International Joint Commission sat at Northport, at Nelson, B.C., and in Washington, D.C., in 1928, 1929 and 1930, and on February 28, 1931, rendered a unanimous report which need not be considered in detail.

After outlining the plans of the Trail Smelter for extracting sulphur from the fumes, the report recommended (Part I, Paragraphs (*a*) and (*c*)) that "the company be required to proceed as expeditiously as may be reasonably possible with the works above referred to and also to erect with due dispatch such further sulphuric acid units and take such further or other action as may be necessary, if any, to reduce the amount and concentration of SO_2 fumes drifting from its said plant into the United States until it has reduced the amount by some means to a point where it will do no damage in the United States".

The same Part I, Paragraph (*g*) gave a definition of "damage":

> The word "damage", as used in this document shall mean and include such damage as the Governments of the United States and Canada may deem appreciable, and for the purposes of paragraphs (*a*) and (*c*) hereof, shall not include occasional damage that may be caused by SO_2 fumes being carried across the international boundary in air pockets or by reason of unusual atmospheric conditions. Provided, however, that any damage in the State of Washington howsoever caused by said fumes on or after January 1, 1932, shall be the subject of indemnity by the company to any interests so damaged. . . .

Paragraph 2 read, in part, as follows:

> In view of the anticipated reduction in sulphur fumes discharged from the smelter at Trail during the present year, as hereinafter referred to, the Commission therefore has deemed it advisable to determine the amount of indemnity that will compensate United States interests in respect to such fumes, up to and including the first day of January, 1932. The Commission finds and determines that all past damages and all damages up to and including the first day of January next, is the sum of $350,000. Said sum, however, shall not include any damage occurring after January 1, 1932.

This report failed to secure the acceptance of both Governments. A sum of $350,000 has, however, been paid by the Dominion of Canada to the United States.

Two years after the filing of the above report, the United States Government, on February 17, 1933, made representations to the Canadian Government that existing conditions were entirely unsatisfactory and that damage was still occurring and diplomatic negotiations were entered into which resulted in the signing of the present Convention.

The Consolidated Mining and Smelting Company of Canada, Limited, proceeded after 1930 to make certain changes and additions in its plant, with the intention and purpose of lessening the sulphur contents of the fumes, and in an attempt to lessen injurious fumigations, a new system of control over the emission of fumes during the crop growing season came into operation about 1934. To the three sulphuric acid plants in operation since 1932, two others have recently been added. The total capacity is now of 600 tons of sulphuric acid per day, permitting, if these units could run continually at capacity, the fixing of approximately 200 tons of sulphur per day. In addition, from 1936, units for the production of elemental sulphur have been put into operation. There are at present three such units with a total capacity of 140 tons of sulphur per day. The capacity of absorption of sulphur dioxide is now 600 tons of sulphur dioxide per day (300 tons from the zinc plant gases and 300 tons from the lead plant gases). As a result, the maximum possible recovery of sulphur dioxide, with all units in full operation has been brought to a figure which is about equal to the amount of that gas produced by smelting operations at the plant in 1939. However, the normal shutdown of operating units for repairs, the power supply, ammonia available, and the general market situation are factors which influence the amount of sulphur dioxide treated.

In 1939, 360 tons, and in 1940, 416 tons, of sulphur per day were oxidized to sulphur dioxide in the metallurgical processes at the plant. Of the above,

for 1939, 253 tons, and for 1940, 289 tons per day, of the sulphur which was oxidized to sulphur dioxide was utilized. One hundred and seven tons

NORTHPORT

(FUMIGATIONS IN HOURS AND MINUTES AT THE CONCENTRATIONS NOTED IN FIRST COLUMN)

1938	April		May		June		July		August		Sept.	
Concentrations p.p.m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.
.11-.25	6	0	0	0	0	20	5	50	10	40	28	20
.26-.50	0	50	0	0	0	0	1	40	3	0	6	0
above .50	0	10	0	0	0	0	0	0	0	5	0	20
Maximum p.p.m.	.66		.08		.15		.33		.61		.51	
1939												
.11-.25	1	40	10	0	9	20	5	20	5	0	25	0
.26-.50	0	0	0	0	2	0	0	0	2	0	3	40
above .50	0	0	0	0	0	0	0	0	0	0	0	0
Maximum p.p.m.	.16		.21		.30		.24		.33		.36	
1940												
.11-.25	16	20	32	40	5	40	9	20	10	0	23	10
.26-.50	2	0	0	0	0	0	0	0	0	0	0	0
above .50	0	0	0	0	0	0	0	0	0	0	0	0
Maximum p.p.m.	.37		.23		.22		.19		.17		.23	

WANETA

(FUMIGATIONS IN HOURS AND MINUTES AT THE CONCENTRATIONS NOTED IN FIRST COLUMN)

1938	June		July		August		September	
Concentrations p.p.m.	h.	m.	h.	m.	h.	m.	h.	m.
.11-.25	13	0	18	40	20	40	56	30
.26-.50	0	50	1	20	3	20	5	20
above .50	0	20	0	0	5	0	0	20
Maximum p.p.m.	.52		.30		1.63		.75	

1939	April		May		June		July		August		Sept.	
	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.
.11-.25	11	55	10	0	20	20	10	40	13	20	16	50
.26-.50	4	40	5	40	8	20	5	0	6	20	9	20
above .50	0	20	0	0	1	20	0	0	0	40	1	40
Maximum p.p.m.	.52		.46		.79		.39		.56		.59	

1940	June		July		August		September	
	h.	m.	h.	m.	h.	m.	h.	m.
.11-.25	5	20	18	20	27	20	28	0
.26-.50	0	0	6	40	4	40	8	40
above .50	0	0	0	0	0	40	0	0
Maximum p.p.m.	.15		.49		.64		.42	

and 127 tons of sulphur per day for those two years, respectively, were emitted as sulphur dioxide to the atmosphere.

The tons of sulphur emitted into the air from the Trail Smelter fell from about 10,000 tons per month in 1930 to about 7,200 tons in 1931 and 3,400 tons in 1932 as a result both of sulphur dioxide beginning to be absorbed and of depressed business conditions. As depression receded, this monthly average rose in 1933 to 4,000 tons, in 1934 to nearly 6,300 tons and in 1935 to 6,800 tons. In 1936, however, it had fallen to 5,600 tons; in 1937, it further fell to 4,850 tons; in 1938, still further to 4,230 tons to reach 3,250 tons in 1939. It rose again, however, to 3,875 tons in 1940.

During the period since January 1, 1932, automatic recorders for registering the presence of sulphur dioxide in the air, as well as the length of fumigations and the maximum concentration in parts per million (p.p.m.) and one hundredth of parts per million, were maintained by the United States on the east side of the river at Northport from 1932 to 1937; and at Boundary in 1932, 1933, and in parts of 1934 and 1935; at Evans, south of Northport, from 1932 to 1934 and parts of 1935; and at Marble, in 1932 and 1933 and part of 1934; and the United States had at various times in 1939 and 1940 a portable recorder at Fowler Farm. The Dominion of Canada maintained recorders at Stroh Farm from 1932 to 1937 and from January to May 1938, and at a point opposite Northport on the west side of the River from 1937 to 1940—both of these recorders being in United States territory; and in Canadian territory, at Waneta, June to December, 1938, January to March, 1939, and June to December 1940, and at Columbia Gardens from May 1937 to December 1940.

Data compiled from the Northport recorder during the growing seasons from April to September, 1938, 1939, and 1940, and from the Waneta recorder during the growing seasons while it was operated from June to September 1938 and 1940, and April to September, 1939, show the number of hours and minutes in each month during which fumes were present at the various concentrations of .11 to .25, .26 to .50, and above .50.

PART TWO.

The first question under Article III of the Convention is: "(1) Whether damage caused by the Trail Smelter in the State of Washington has occurred since the first day of January, 1932, and, if so, what indemnity should be paid therefor."

This question has been answered by the Tribunal in its previous decision, as to the period from January 1, 1932 to October 1, 1937, as set forth above.

Concerning this question, three claims are now propounded by the United States.

I.

The Tribunal is requested to "reconsider its decision with respect to expenditures incurred by the United States during the period January 1, 1932, to June 30, 1936". It is claimed that "in this respect the United States is entitled to be indemnified in the sum of $89,655, with interest at the rate of five per centum per annum from the end of each fiscal year in which the several amounts were expended to the date of the Tribunal's final decision".

This claim was dealt with in the previous decision (Part Two, Clause (7)) and was disallowed.

The indemnity found by the Tribunal to be due for damage which had occurred since the first day of January, 1932, up to October 1, 1937, *i.e.*, $78,000, was paid by the Dominion of Canada to the United States and received by the latter without reservations. (Record, Vol. 56, p. 6468.) The decision of the Tribunal in respect of damage up to October 1, 1937, was thus complied with in conformity with Article XII of the Convention. If it were not, in itself, final in this respect, the decision would have assumed a character of finality through this action of the parties.

But this finality was inherent in the decision. Article XI of the Convention says: "The Tribunal shall report to the Governments its final decisions .... as soon as it has reached its conclusions in respect to the questions...." and Article XII of the Convention, "The Governments undertake to take such action as may be necessary in order to ensure due performance of the obligations undertaken hereunder, in compliance with the decision of the Tribunal."

There can be no doubt that the Tribunal intended to give a final answer to Question I for the period up to October 1, 1937. This is made abundantly clear by the passage quoted above, in particular by the words: "This decision is not subject to alteration or modification by the Tribunal hereafter."

It might be argued that the words "as soon as it reached its conclusions in respect to the questions" show that the "final decisions" mentioned in Article XI of the Convention were not to be final until all the questions should have been answered.

In proceeding as it did the Tribunal did not act exclusively on its own interpretation of the Convention. It stated to the Governments its intention of granting damages for the period down to October 1, 1937, whilst ordering further investigations before establishing a permanent régime. It is with this understanding that both Governments, by an exchange of letters between the Minister of the United States at Ottawa and the Secretary of State of the Dominion of Canada (March 14, 1938, March 22, 1938), concurred in the extension of time requested.

This interpretation of Article XI of the Convention, moreover, is not in contradiction with the intention of the parties as expressed in the Convention. It was not foreseen at the time that further investigations might be needed, after the hearings had been ended, as proved to be the case. But the duty was imposed upon the Tribunal to reach a solution just to all parties concerned. This result could not have been achieved if the Tribunal had been forced to give a permanent decision as to a régime on the basis of data which it and both its scientific advisers considered inadequate and unsatisfactory. And, on the other hand, it is obvious that equity would not have been served if the Tribunal, having come to the conclusion that damage had occurred after January 1, 1937, had withheld its decision granting damages for more than two and one half years.

The Tribunal will now consider whether its decision concerning Question No. 1, up to October 1, 1937, constitutes *res judicata*.

As Dr. James Brown Scott (*Hague Court Reports*, p. XXI) expressed it: ".... in the absence of an agreement of the contending countries excluding the law of nations, laying down specifically the law to be applied, international law is the law of an international tribunal". In deciding in conformity with international law an international tribunal may, and, in fact, frequently does apply national law; but an international tribunal will not depart from the rules of international law in favor of divergent rules of

national law unless, in refusing to do so, it would undoubtedly go counter to the expressed intention of the treaties whereupon its powers are based. This would particularly seem to be the case in matters of procedure. In this respect attention should be paid to the rules of procedure adopted by this Tribunal with the concurrence of both Agents on June 22, 1937, wherein it is said (Article 16): "With regard to any matter as to which express provision is not made in these rules, the Tribunal shall proceed as international law, justice and equity may require." Undoubtedly such provisions could not prevail against the Convention, but they show, at least, how, in the common opinion of the Tribunal and of the Agents, Article IV of the Convention was understood at the time. According to the latter, the Tribunal shall apply the law and practice followed in dealing with cognate questions in the United States of America as well as international law and practice. This text does not bind the Tribunal to apply national law and practice to the exclusion of international law and practice.

It is further to be noted that the words "the law and practice followed in the United States" are qualified by "in dealing with cognate questions". Unless these latter words are disregarded, they mean a limitation of the reference to national law. What this limitation is, becomes apparent when one refers to the questions set forth in the previous article. These questions are questions of damage caused by smelter fumes, of indemnity therefor, of measures or régime to be adopted or maintained by the Smelter with or without indemnity or compensation. They may be questions of law or questions of practice. The practice followed, for instance, in injunctions dealing with problems of smelter fumes may be followed in so far as the nature of an arbitral tribunal permits. But general questions of law and practice, such as the authority of the *res judicata* and the exceptions thereto, are not "cognate questions" to those of Article III.

This interpretation is confirmed by the correspondence exchanged between parties, as far as it is part of the record. On February 22, 1934, the Canadian Government declared (letter of the Secretary of State for External Affairs to the Minister of the United States at Ottawa) that it "would be entirely satisfied to refer the Tribunal to the principles of law as recognized and applied by the courts of the United States of America in such matters". Now, the matters referred to in that sentence are determined by the preceding sentences:

> The use of the word "injury" is likely to cause misunderstanding which should be removed when the actual terms of the issue are settled for inclusion in the Convention. In order to avoid such misunderstanding, it would seem to be desirable to use the word "damage" in place of "injury" and further, either to define the word actually used by a definition to be incorporated in the Convention or else by reference to the general principles of the law which are applied by the courts in the two countries in dealing with cognate matters.

This passage shows that the "cognate questions" parties had in mind in drafting the Convention were primarily those questions which in cases between private parties, find their answer in the law of nuisances.

That the sanctity of *res judicata* attaches to a final decision of an international tribunal is an essential and settled rule of international law.

If it is true that international relations based on law and justice require arbitral or judicial adjudication of international disputes, it is equally true

that such adjudication must, in principle, remain unchallenged, if it is to be effective to that end.

Numerous and important decisions of arbitral tribunals and of the Permanent Court of International Justice show that this is, in effect, a principle of international law. It will be sufficient, at this stage, to refer to some of the more recent decisions.

In the decisions of an arbitral tribunal constituted under the statute of the Permanent Court of Arbitration concerning the Pious Funds of California (October 14, 1902, *Hague Court Reports*, 1916, p. 3) the question was whether the claim of the United States on behalf of the Archbishop of San Francisco and the Bishop of Monterey was governed by the principle of *res judicata* by virtue of the arbitral award of Sir Edward Thornton. This question was answered in the affirmative.

The Fabiani case (French-Venezuelan Claims Commission, Ralston's Report, Decision of Umpire Plumley, p. 110) is of particular interest for the present case.

There had been an award by the President of the Swiss Confederation allowing part of a claim by France on behalf of Fabiani against Venezuela and disallowing the rest. As the terms of reference to the second arbitral tribunal were broader than to the first, it was contended by the claimants "that of the sums denied allowance by the honorable Arbitrator of Bern there are certain portions so disposed of by him as to be still in force against the respondent Government under the general terms of the protocol constituting this Commission". The first Arbitrator had eliminated all claims based on alleged arbitrary acts (*faits du prince*) of executive authorities as not being included in the matter submitted to his jurisdiction which he found limited by treaty to "denial of justice", a concept which he interpreted as confined to acts and omissions of judicial authorities. It was argued, on behalf of claimants, that "the doctrine and jurisprudence are for a long time unanimous upon this incontestable principle that a declaration of incompetency can never produce the effect of *res judicata* upon the foundation of the law". Umpire Plumley rejected these contentions. "In the interest of peace", a limitation had been imposed upon diplomatic action by a treaty the meaning whereof had been "finally and conclusively" settled "as applied to the Fabiani controversy" by the first award. The definition of denial of justice and the determination of the responsibility of the respondent Government were not questions of jurisdiction. And the Umpire concluded that "the compromise arranged between the honorable Governments .... followed by the award of the honorable President of the Swiss Confederation .... were 'acting together' a complete, final and conclusive disposition of the entire controversy on behalf of Fabiani".

Again in the case of the claim of the Orinoco Steamship Company between the United States and Venezuela, an arbitral tribunal constituted under the statute of the Permanent Court of Arbitration (October 25, 1910, *American Journal of International Law*, V, p. 230) emphasized the importance in international disputes of the principle of *res judicata*. The first question for the arbitral tribunal to decide was whether the decision previously rendered by an umpire in this case "in view of all the circumstances and under the principles of international law" was "not void, and whether it must be considered to be so conclusive as to preclude a re-examination of the case on its merits". As we will presently see, the tribunal held that the decision was partially void for excess of power. This, however, was rigidly limited and the principle affirmed as follows: ".... it is assuredly in the interest of peace

and the development of the institution of international arbitration so essential to the well-being of nations, that, in principle, such a decision be accepted, respected and carried out by the parties without reservation".

In three successive advisory opinions, regarding the delimitation of the Polish Czechoslovak frontier (Question of Jaworzina, No. 8, Series B, p. 38), the delimitation of the Albanian frontier at the Monastery of Saint Naoum (No. 9, Series B, p. 21, 22), and the Polish Postal service in the Free City of Danzig (No. 11, Series B, p. 24), the Permanent Court of International Justice based its appreciation of the legal effects of international decisions of an arbitral character on the underlying principle of *res judicata*.

This principle was affirmed in the judgment of the Court on the claim of Belgium against Greece on behalf of the *Société Commerciale de Belgique* (Series A/B, No. 78, p. 174), wherein the Court said: ". . . . since the arbitral awards to which these submissions relate are, according to the arbitration clause under which they were made, 'final and without appeal', and since the Court has received no mandate from the parties in regard to them, it can neither confirm nor annul them either wholly or in part".

In the well-known case of Frelinghuysen *v.* Key (110 U.S. 63, 71, 72), the Supreme Court of the United States, speaking of an award of the United States Mexican Claims Commission, under the Convention of July 4, 1868, whereby (Art. V) parties agreed, *inter alia*, to consider the result of the proceedings as a "full, perfect, and final settlement of every claim", said: "As between the United States and Mexico, the awards are final and conclusive until set aside by agreement between the two Governments or otherwise."

There is no doubt that in the present case, there is *res judicata*. The three traditional elements for identification: parties, object and cause (Permanent Court of International Justice, Judgment 11, Series A, No. 13, Dissenting Opinion by M. Anzilotti, p. 23) are the same. (*Cf.* Permanent Court of International Justice, Series B, No. 11, p. 30.)

Under the Statute of the Permanent Court of International Justice whereby (Article 59) "The decision of the Court has no binding force except between the parties and in respect of that particular case", the Permanent Court of International Justice, in an interpretative judgment (Judgment No. 11, Series A, No. 13, pp. 18, 20—Chorzów Case), expressed the opinion that the force of *res judicata* was inherent even in what was an incidental decision on a preliminary point, the ownership of the Oberschlesische Company. The minority judge, M. Anzilotti, pointed out that "under a generally accepted rule which is derived from the very conception of *res judicata*, decisions on incidental or preliminary questions which have been rendered with the sole object of adjudicating upon the parties' claims are not binding in another case" (same decision, p. 26). Later on, in the same case (Judgment 13, Series A, No. 17, Dissenting Opinion of M. Ehrlich, pp. 75, 76), M. Ehrlich, the dissenting national judge appointed by Poland, adopted this statement. But M. Anzilotti (Judgment 11, Series A, No. 13, Dissenting Opinion, p. 27) did not expressly answer in the negative the question which he formulated, namely: "Does this general rule also cover the case of an action for indemnity following upon a declaratory judgment in which the preliminary question has been decided?" It is true that, when the case came up again on the question of indemnity (Judgment 13, Series A, No. 17, pp. 31, 32), the Court seems to have avoided—as M. Ehrlich pointed out—the assertion that there was *res judicata* and reserved the effect of its incidental decision "as regards the right of ownership

under municipal law". But the Court said: ". . . . it is impossible that the Oberschlesische's right to the Chorzów factory should be looked upon differently for the purposes of that judgment (the previous Judgment No. 7 wherein it was decided that the attitude of the Polish Government in respect of the Oberschlesische was not in conformity with international law) and in relation to the claim for reparation based on the same judgment", thus admitting in effect (M. Anzilotti now concurring) that it was bound by its previous decision.

In the present case, the decision was not preliminary or incidental. Neither was it a decision on a question of jurisdiction. There is some authority (Tiedemann *v.* Poland, *Recueil des Décisions des Tribunaux Arbitraux Mixtes*, Tome VII (1928), p. 702), in support of the contention that a decision upon the question of jurisdiction only, may, under certain circumstances, be reversed by the same court; and it might be argued, as, in fact, was done by France in the Fabiani case, that a decision merely denying jurisdiction can never constitute *res judicata* as regards the merits of the case at issue. But assuming the first contention to be correct as the second undoubtedly is, that would not affect the issue in the present case. Here, as in the Fabiani case, the decision was not one denying jurisdiction.

The United States does not contend that the previous decision is void for excess of power, but asks for reconsideration and revision, as far as the costs of investigation are concerned, on account of a material error of law (Record, p. 6540).

In the absence of agreement between parties, the first question concerning a request tending to revision of a decision constituting *res judicata*, is: can such a request ever be granted in international law, unless special powers to do so have been expressly given to the tribunal?

The Convention for the Pacific Settlement of Disputes signed at The Hague, October 18, 1907 (Article 83) says: "The parties can reserve in the compromis the right to demand the revision of the award." In that case only, does the article apply. But, on the other hand, the Statute of the Permanent Court of International Justice (Article 61) does not require the grant of such special powers to the Court.

In the Jaworzina case (Advisory Opinions, Series B, No. 8, p. 37), the Permanent Court of International Justice expressed the opinion that the Conference of Ambassadors, which had acted in a quasi-arbitral capacity, did not retain the power to modify its decision, as it had fulfilled the task entrusted to it by giving the latter. In the case of Saint Naoum Monastery, however (Advisory Opinions, Series B, No. 9, p. 21), the Court seemed less positive as to the possibility of a revision in the absence of an express reservation to that effect.

Arbitral decisions do not give to the question an unanimous answer. Thus, in the United States Mexican Mixed Claims Commission of 1868, whilst Umpire Lieber, on a motion for rehearing, re-examined the case, Umpire Thornton, in the Weil, LaAbra, and other cases, refused a rehearing, *inter alia* on the ground that the provisions of the Convention in effect debarred him from rehearing cases which he had already decided (Moore, *International Arbitrations*, 1329, 1357). In the single case of Schreck, however, he granted a request of one of the Agents to reconsider his decision. The case also of A. A. Green (Moore, *International Arbitrations*, 1358) was reconsidered by the Umpire and that of G. Moore (Moore, *International Arbitrations*, 1357) by the two Commissioners. In the Lazare case (Haiti *v.* United States), the Arbitrator, Mr. Justice Strong, refused a rehearing, "solely for

the reason", that in his opinion, his "power over the award was at an end" when it "had passed from his hands and been filed in the State Department". (Moore, *International Arbitrations*, 1793.) In the Sabotage cases, before the American-German Mixed Claims Commission, the Umpire, Mr. Justice Roberts, granted a rehearing, although there was no express provision in the agreement empowering the Commission to do so (December 15, 1933, Documents, p. 1122, *American Journal of International Law*, 1940, pp. 154, 164).

Whether final, in part, or not, the previous decision did not give final answers to all the questions. The Tribunal, by that decision, did not become *functus officio*. Part of its task was yet before it when the request for revision was presented. Under those circumstances, the difficulties and uncertainties do not arise that might present themselves where an arbitral tribunal, having completed its task and finally adjourned, would be requested to reconsider its decision.

The Tribunal, therefore, decides that, at this stage, at least, the Convention does not deny it the power to grant a revision. (*Cf.* D. V. Sandifer, *Evidence before International Tribunals*, 1939, p. 299.)

The second question is whether revision should be granted; and this question subdivides itself into two separate parts: first, whether the petition for revision should be entertained, and second, if entertained, whether the previous decision should be revised in view of the considerations presented by the United States.

It is the rule under the Hague Convention for the Pacific Settlement of Disputes (Article 83) that the question whether a revision should be entertained must be dealt with separately. Such is also the rule according to Article 61 of the Statute of the Permanent Court of International Justice. It is true that, in the case of the Orinoco Steamship Company, the arbitral tribunal did not consider separately the question whether the previous award was void and the question of the merits; but the decision, in that respect, does not seem to conform to the compromis which clearly separated the two questions.

In the Sabotage cases and in other cases before the Mixed Claims Commission, United States and Germany, a contrary practice had prevailed. But when the question of revision came to a head, the Umpire, Mr. Justice Roberts (decision of December 15, 1933, Documents, p. 1115; *American Journal of International Law*, 1940, pp. 157-158), said: "I am convinced as the matter is now viewed in retrospect that it would have been fairer to both the parties, definitely to pass in the first instance upon the question of the Commission's power. . . . Orderly procedure would have required that these issues be decided by the Umpire before the filing of the tendered evidence. The American Agent has . . . . filed a very large quantity of evidence which . . . . I have thought it improper to examine." As the position apparently required further elucidation, a motion was presented to determine "whether the next hearing shall be merely of a preliminary nature" (Documents, p. 1159). The Umpire decided that it should, saying: "Germany insists that the preliminary question be determined separately. I am of opinion this is her right."

The Tribunal is of opinion that this procedure should be followed.

As said above, the petition is founded upon an alleged error in law. It is contended by the United States that the Tribunal erred in the interpretation of the Convention when it decided that the monies expended for the investigation undertaken by the United States Government of the problems created in the United States by the operation of the Smelter at Trail could not be

included within the "damage caused by the Trail Smelter" (Article III (1) of the Convention, Record, p. 6030). Statements by the Tribunal that the controversy did not involve "any such type of facts as the persons appointed" in the *I'm Alone* case "felt to justify them in awarding to Canada damages for violation of sovereignty" and that in cases where a private claim was espoused "damages awarded for expenses were awarded, not as compensation for violation of national sovereignty, but as compensation for expenses incurred by individual claimants in prosecuting their claims for wrongful acts by the offending Government" were also challenged, although petitioner added that possibly these further statements might be regarded as dicta. (Record, p. 6040.) It was further argued that the solution adopted by the Tribunal was not a "solution just to all parties concerned", as required by Article IV of the Convention.

According to the Hague Convention (Article 83), a request tending to the revision of an award can only be made on the ground of the discovery of some new fact calculated to exercise a decisive influence upon the award and which at the time the discussion was closed was unknown to the Tribunal and to the party demanding the revision.

It is noteworthy that, at the first Hague Conference, the United States Delegation submitted a proposal whereby every party was entitled to a second hearing before the same judges within a certain period of time "if it declares that it can call new witnesses or raise questions of law not raised or decided at the first hearing". This proposal was, however, considered as weakening unduly the principle of *res judicata*. The text, as it now stands, was adopted as a compromise between the American view and the views of those who, such as de Martens, were opposed to any revision. The Statute of the Permanent Court of International Justice (Article 61) substantially coincides with the Hague Convention: "An application for revision of a judgment can be made only when it is based upon the discovery of some fact of such a nature as to be a decisive factor, which fact was, when the judgment was given, unknown to the court and also to the party claiming revision, always provided that such ignorance was not due to negligence." In presenting this text, the report of the Advisory Committee of Jurists (*Procès-Verbaux*, p. 744) said very aptly: "The right of revision is a very important right and affects adversely in the matter of *res judicata* a point which for the sake of international peace should be considered as finally settled. Justice, however, has certain legitimate requirements." These requirements were provided for in the text which enables the court to bring its decision in harmony with justice in cases where, through no fault of the claimant, essential facts remained undisclosed or where fraud was subsequently discovered. No error of law is considered as a possible basis for revision, either by the Hague Convention or by the Statute of the Permanent Court of International Justice.

The Permanent Court of International Justice left open, in the Saint Naoum case (Series B, p. 21), the question whether, in the absence of express provision, an award could be revised "in the event of the existence of an essential error being proved or of new facts being relied on".

Except for those cases where a second hearing before the same or another Tribunal was agreed upon between the Governments or their Agents in the case, there are few cases of awards where rehearing or revision was granted.

In the Green case, quoted above (Moore, *International Arbitrations*, 1358), the Umpire granted a rehearing because certain evidence which was before the Commissioners was not transmitted to him. In the case of George

Moore, also quoted above (Moore, *International Arbitrations*, 1357), a new document was produced. In the latter case, the Commissioners stated that it was their practice to grant revision where new evidence was such as ought undoubtedly to produce a change in the minds of the Commission except where there might be some gross laches or injustice would probably be done to the defendant Government. In the single case of Schreck, also quoted above (Moore, *International Arbitrations*, 1357), Umpire Thornton reconsidered his decision at the request of the Agent of the claimant Government and, in this case, the revision was granted because he found that he had clearly committed an error in law. Because a claimant was born in Mexico, he had taken for granted that he had Mexican nationality. "The Agent of the United States produced the appropriate law of Mexico, by which it appeared that the assumption was clearly erroneous."

In the case of the Orinoco S. S. Company where, it will be remembered, the question before the arbitral tribunal was whether the award in a previous arbitration was void, the defendant State, Venezuela, argued that the decision was not void as the compromis was valid, there had been no excess of power, nor alleged corruption of the judges, nor any "essential error" in the decision.

There were several claims the rejection of which by the Umpire in the first arbitration, Mr. Barge, was considered separately. The main claim had been disallowed on three grounds: the first was the interpretation of a contract between the Venezuelan Government and a concessionaire; the second was a so-called Calvo clause and the third was lack of compliance both with the contract and with Venezuelan law in omitting to notify to the Venezuelan Government the cession of the contract.

Under the terms of reference, the first arbitrators were to decide "on a basis of absolute equity without regard to objections of a technical nature or to the provisions of local legislations". It was clearly apparent from the circumstances of the case that the second and third grounds were entirely irreconcilable with these terms. Nevertheless, the second arbitral tribunal did not upset the findings of Umpire Barge as regards the main claim. The second award said: .

> Whereas the appreciation of the facts of the case and the interpretation of the documents were within the competence of the Umpire and, as his decisions, when based on such interpretation, are not subject to revision by this Tribunal, whose duty it is, not to say if the case has been well or ill judged, but whether the award must be annulled; that if an arbitral decision could be disputed on the ground of erroneous appreciation, appeal and revision, which the Conventions of The Hague of 1899 and 1907 made it their object to avert, would be the general rule.

Other and much smaller claims, however, had been disallowed exclusively on grounds two and three. Here the decision was considered void for excess of power.

The Sabotage cases were re-opened on the allegation that the decisions had been induced by fraud and the decisions were revised when this was proved. This obviously falls within the limits set up both by the Hague Convention and by the Statute of the Permanent Court of International Justice. The following passage of the decision of the Umpire, Mr. Justice Roberts, relied upon by the petitioner in this case, is therefore in the nature of a dictum:

> I think it clear that where the Commission has misinterpreted the evidence, or made a mistake in calculation, or where its decision does

not follow its fact findings, or where in any other respect the decision does not comport with the record as made, or where the decision involves a material error of law, the Commission not only has power, but is under the duty, upon a proper showing, to re-open and correct a decision to accord with the facts and the applicable legal rules.

This statement may be entirely justified by circumstances special to the Mixed Claims Commission, in particular by the practice followed *ab initio* by this Commission, apparently with the concurrence, until the Sabotage cases reached their last stages, of the Umpire, the Commissioners and the Agents, but in so far as it does not refer to the correction of possible errors arising from a slip or accidental omission, it does not express the opinion generally prevailing as to the position in international law, stated for instance in the following passage of a recent decision: ".... in order to justify revision it is not enough that there has taken place an error on a point of law or in the appreciation of a fact, or in both. It is only lack of knowledge on the part of the judge and of one of the parties of a material and decisive fact which may in law give rise to the revision of a judgment" (de Neuflize *v.* Disconto Gesellschaft, *Recueil des Décisions des Tribunaux Arbitraux Mixtes*, t. VII, 1928, 629) [1].

A mere error in law is no sufficient ground for a petition tending to revision.

The formula "essential error" originated in a text voted by the International Law Institute in 1876. From its inception, its very authors were divided as to its meaning. It is thought significant that the arbitral tribunal in the Orinoco case avoided it; the Permanent Court in the Saint Naoum case alluded to it. The Government of the Kingdom of the Serbs, Croats and Slovenes alleged essential error both in law and in fact (Series C, No. 5, II, p. 57, Pleadings by Mr. Spalaikovitch), but what the Court had in mind in the passage quoted above (see p. 36 of the present decision), was only a possible error in fact. The paragraph where this passage appears begins with the words: "This decision has also been criticized on the ground that it was based on erroneous information or adopted without regard to certain essential facts."

The Tribunal is of opinion that the proper criterion lies in a distinction not between "essential" errors in law and other such errors, but between "manifest" errors, such as that in the Schreck case or such as would be committed by a tribunal that would overlook a relevant treaty or base its decision on an agreement admittedly terminated, and other errors in law. At least, this is as far as it might be permissible to go on the strength of precedents and practice. The error of interpretation of the Convention alleged by the petitioner in revision is not such a "manifest" error. Further criticisms need not be considered. The assumption that they are justified would not suffice to upset the decision.

For these reasons, the Tribunal is of opinion that the petition must be denied.

II (*a*).

The Tribunal is requested to say that damage has occurred in the State of Washington since October 1, 1937, as a consequence of the emission of sulphur dioxide by the smelters of the Consolidated Mining and Smelting

[1] This decision refers to the rules of procedure of the Franco-German Mixed Arbitral Tribunals but these rules themselves are expressive of the opinion generally prevailing as to the position in international law.

Company at Trail, B.C., and that an indemnity in the sum of $34,807 should be paid therefor.

It is alleged that acute damage has been suffered, in 1938-1940, in an area of approximately 6,000 acres and secondary damage, during the same period, in an area of approximately 27,000 acres. It is also alleged that damage has been suffered in the town of Northport, situated in the latter area. On the basis of investigations made in 1939 and 1940, the area of acute damage is claimed to extend on the western bank of the Columbia River to a point approximately due north of the mouth of Deep Creek, the average width of this area on this bank being about 1½ miles, and on the eastern bank of the river, to a point somewhat to the south of the northern limit of Section 20, T. 40, R. 41, the width of this area on that bank varying from approximately 1¼ miles at the border to ¼ mile at its lower end. The area of secondary damage is claimed to extend on both banks of the river to about one mile below Northport; it extends laterally, at the boundary, westward to the western limit of Section 2, T. 40, R. 40, and eastward to the eastern limit of Section 1, T. 40, R. 41; it extends along Cedar Creek above Section 14, T. 40, R. 41, along Nigger Creek to the middle of Section 9, T. 40, R. 40, along Little Sheep Creek to the middle of Section 10, T. 40, R. 39, along Big Sheep Creek to the western limit of Section 15, T. 40, R. 39, and along Deep Creek, to the southeastern corner of Section 14, T. 39, R. 40. It is to be noted that the area of damage alleged by the United States in its original statement of case was about 144,000 acres.

Damage is claimed, as to the area of acute damage, on the basis of $0.8525 per acre, on all lands whether cleared or not cleared and whether used for crops, timber or other purposes. It is equally claimed, as to the area of secondary damage, on the basis of $1.0511, on all lands. It is alleged that damage occurred, in 1932-1937, in the area of acute damage to the extent of $17,050; in the area of secondary damage, to the extent of $189,200 and in the town of Northport, to the extent of $8,750. The damage for 1938-1940 is supposed to be 0.3 of the first amount in the area of acute damage, and 0.15 of the second and the third amount, respectively, in the area of secondary damage and in the town of Northport.

The request for an indemnity in the sum of $34,807 is based on the final paragraph of Part Two of the previous decision, quoted above, where it is said that the Tribunal would determine in its final decision the fact of the existence of damage, if any, occurring after October 1, 1937, and the indemnity to be paid therefor.

The present report covers the period until October 1, 1940.

The Tribunal has considered not only the pertinent evidence (including data from the recorders located by the United States and by Canada) introduced at the hearings at Washington, D.C., Spokane and Ottawa in 1937, but also the following: (*a*) the Reports of the Technical Consultants appointed by the Tribunal to superintend the experimental period from April 16, 1938, to October 1, 1940, as well as their reports of the personal investigations in the area at various times within that period; (*b*) the candid reports of his investigations in the area in 1939 and 1940 by the scientist for the United States, Mr. Griffin; (*c*) the monthly sulphur balance sheets of the operations of the Smelter; (*d*) all data from the recorders located at Columbia Gardens, Waneta, Northport, and Fowler's Farm; (*e*) the census data and all other evidence produced before it.

The Tribunal has examined carefully the records of all fumigations specifically alleged by the United States as having caused or been likely to cause

damage, as well as the records of all other fumigations which may be considered likely to have caused damage. In connection with each such instance, it has taken into detailed consideration, with a view of determining the fact or probability of damage, the length of the fumigation, the intensity of concentration, the combination of length and intensity, the frequency of fumigation, the time of day of occurrence, the conditions of humidity or drouth, the season of the year, the altitude and geographical locations of place subjected to fumigation, the reports as to personal surveys and investigations and all other pertinent factors.

As a result, it has come to the conclusion that the United States has failed to prove that any fumigation between October 1, 1937, and October 1, 1940, has caused injury to crops, trees or otherwise.

II (*b*).

The Tribunal is finally requested as to Question I to find with respect to expenditures incurred by the United States during the period July 1, 1936, to September 1, 1940, that the United States is entitled to be indemnified in the sum of $38,657.79 with interest at the rate of five per centum per annum from the end of each fiscal year in which the several amounts were expended to the date of the Tribunal's final decision.

So far as claim is made for indemnity for costs of investigations undertaken between July 1, 1936, and October 1, 1937, it cannot be allowed for the reasons stated above with reference to costs of investigations from January 1, 1932, to June 30, 1936. The Tribunal, therefore, will now consider the question of the costs of investigations made since October 1, 1937.

Under Article XIV, the Convention took effect immediately upon exchange of ratifications. Ratifications were exchanged at Ottawa on August 3, 1935. Thus, the Convention was in force at the beginning of the period covered by this claim. Under the Convention (Article XIII) each Government shall pay the expenses of the presentation and conduct of its case before the Tribunal. Whatever may have been the nature of the expenditures previously incurred, the Tribunal finds that monies expended by the United States in the investigation, preparation and proof of its case after the Convention providing for arbitral adjudication, including the aforesaid provision of Article XIII, had been concluded and had entered into force, were in the nature of expenses of the presentation of the case. An indemnity cannot be granted without reasonable proof of the existence of an injury, of its cause and of the damage due to it. The presentation of a claim for damages includes, by necessary implication, the collection in the field of the data and the preparation required for their presentation as evidence in support of the statement of facts provided for in Article V of the Convention.

It is argued that where injury has been caused and the continuance of this injury is reasonably feared, investigation is needed and that the cost of this investigation is as much damageable consequence of the injury as damage to crops and trees. It is argued that the indemnity provided for in Question No. 1 necessarily comprises monies spent on such investigation.

There is a fundamental difference between expenditure incurred in mending the damageable consequences of an injury and monies spent in ascertaining the existence, the cause and the extent of the latter.

These are not part of the damage, any more than other costs involved in seeking and obtaining a judicial or arbitral remedy, such as the fees of

counsel, the travelling expenses of witnesses, etc. In effect, it would be quite impossible to frame a logical distinction between the costs of preparing expert reports and the cost of preparing the statements and answers provided for in the procedure. Obviously, the fact that these expenditures may be incurred by different agencies of the same government does not constitute a basis for such a logical distinction.

The Convention does not warrant the inclusion of the cost of investigations under the heading of damage. On the contrary, apart from Article XIII, both the text of the Convention and the history of its conclusion disprove any intention of including them therein.

The damage for which indemnity should be paid is the damage caused by the Trail Smelter in the State of Washington. Investigations in the field took place there and it happens that experiments were conducted in that State. But these investigations were conducted by Federal agencies. The "damage"—assuming *ex hypothesi* that monies spent on the salaries and expenditures of the investigators should be so termed—was therefore caused, not in one State in particular, but in the entire territory of the Union.

The word "damage" is used in several passages of the Convention. It may not have everywhere the same meaning but different meanings should not be given to it in different passages without some foundation either in the text itself or on its history. It first occurs in the preamble where it is said that "fumes discharged from the Smelter .... have been causing damage in the State of Washington". It then appears in Article I, where it is said that the $350,000 to be paid to the United States will be "in payment of all damage which occurred in the United States .... as a result of the operation of the Trail Smelter". In Article III itself, the word appears twice. The Tribunal is asked "whether damage caused by the Trail Smelter in the State of Washington has occurred" and "whether the Trail Smelter should be required to refrain from causing damage in the State of Washington in the future and, if so, to what extent". Article X secures to qualified investigators access to the properties "upon which damage is claimed to have occurred or to be occurring". Finally, Article XI deals with "indemnity for damage .... which may occur subsequently to the period of time covered by the report of the Tribunal".

The underlying trend of thought strongly suggests that, in all these passages, the word "damage" has the same meaning, although in Article X, its scope is limited to damage to property by the context.

The preamble states that the damage complained of is damage caused by fumes in the State of Washington and there is every reason to admit that this, and this alone, is what is meant by the same word when it is used again in the text of the Convention.

Although no part of the report of the Joint Commission was formally adopted by both Governments, there is no doubt that, when the sum of $350,000 mentioned in Article I was agreed upon, parties had in mind the indemnity suggested by that Commission. It was, at least, in fact, a partial acceptance of the latter's suggestions. (See letters of the Minister of the United States at Ottawa to the Secretary of State for External Affairs of Canada, of January 30, 1934, and of the latter to the former of February 17, 1934.) There is also no doubt that, in the sum of $350,000 suggested by the Commission, no costs of investigation were included. This is conclusively proved by Paragraphs 2 and 3 of the Report of the International Joint Commission where it is recommended that this sum should be held by the Treasury of the United States as a trust fund to be distributed to the persons

"damaged by.... fumes" by an appointee of the Governor of the State of Washington and where it is said that no allowance was included for indemnity for damage to the lands of the Government of the United States. If, with that report before them, parties intended to include costs of investigations in the word "damage", as used in Article III, they would no doubt have expressed their intention more precisely.

It was argued in this connection on behalf of the United States that, whilst the terms of reference to the International Joint Commission spoke of the "extent to which property in the State of Washington has been damaged", the terms of reference to the arbitral Tribunal do not contain the same limitation to property. It is, however, to be noted that, whilst no indemnity was actually claimed for damage to the health of the inhabitants, the existence of such damage was asserted by interested parties at the time. (See letter of the Minister of the United States at Ottawa to the Secretary of State for External Affairs of Canada, of January 30, 1934.) The difference in the terms of reference may further be accounted for by the circumstance that the case was presented to this Tribunal, not as a sum of individual claims for damage to private properties, espoused by the Government, but as a single claim for damage to the national territory.

If, under the Convention, the monies spent by the United States on investigations cannot be looked upon as damage, no indemnity can be claimed therefor, under the latter, even if such expenses could not properly be included in the "expenses of the presentation and conduct" of the case. If there were a gap in the Convention, the claim ought to be disallowed, as it is unsupported by international practice.

When a State espouses a private claim on behalf of one of its nationals, expenses which the latter may have incurred in prosecuting or endeavoring to establish his claim prior to the espousal are sometimes included and, under appropriate conditions, may legitimately be included in the claim. They are costs, incidental to damage, incurred by the national in seeking local remedy or redress, as it is, as a rule, his duty to do, if, on account of injury suffered abroad, he wants to avail himself of the diplomatic protection of his State. The Tribunal, however, has not been informed of any case in which a Government has sought before an international jurisdiction or been allowed by an international award or judgment indemnity for expenses by it in preparing the proof for presenting a national claim or private claims which it had espoused; and counsel for the United States, on being requested to cite any precedent for such an adjudication, have stated that they know of no precedent. Cases cited were instances in which expenses allowed had been incurred by the injured national, and all except one prior to the presentation of the claim by the Government [1].

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[1] Santa Clara Estates Company, British Venezuelan Commission of 1903 (Ralston's Report, pp. 397, 402); Orinoco Steamship Company (United States) *v.* Venezuela (Ralston's Report, p. 107); United States-Venezuelan Arbitration at The Hague, 1909, p. 249 (Foreign Relations of the United States, 1911, p. 752); Compagnie Générale des Asphaltes de France, British-Venezuelan Arbitration (Ralston's Report, pp. 331, 340); H. J. Randolph Hemming under the Special Agreement of August 18, 1910 (Nielsen's Report, pp. 620, 622); Shufeldt (United States *v.* Guatemala), Department of State Arbitration Series No. 3, p. 881; Mather and Glover *v.* Mexico (Moore, International Arbitrations, pp. 3231-3232); Patrick H. Cootey *v.* Mexico (Moore, International Arbitrations, pp. 2769-2970); The Louisa (Moore, International Arbitrations,

In the absence of authority established by settled precedents, the Tribunal is of opinion that, where an arbitral tribunal is requested to award the expenses of a Government incurred in preparing proof to support its claim, particularly a claim for damage to the national territory, the intent to enable the Tribunal to do so should appear, either from the express language of the instrument which sets up the arbitral tribunal or as a necessary implication from its provision. Neither such express language nor implication is present in this case.

It is to be noted from the above, that even if the Tribunal had the power to re-open the case as to the expenditures by the United States from January 1, 1932, to October 1, 1937, the Tribunal would have reached the same conclusion as to such expenditures and would have been obliged to affirm its decision made in the Report filed on April 16, 1938.

Since the Tribunal has, in its previous decision, answered Question No. 1 with respect to the period from the first day of January, 1932, to the first day of October, 1937, it now anwers Question No. 1 with respect to the period from the first day of October, 1937, to the first day of October, 1940, as follows:

(1) No damage caused by the Trail Smelter in the State of Washington has occurred since the first day of October, 1937, and prior to the first day of October, 1940, and hence no indemnity shall be paid therefor.

PART THREE.

The second question under Article III of the Convention is as follows:

> In the event of the answer to the first part of the preceding question being in the affirmative, whether the Trail Smelter should be required to refrain from causing damage in the State of Washington in the future and, if so, to what extent?

Damage has occurred since January 1, 1932, as fully set forth in the previous decision. To that extent, the first part of the preceding question has thus been answered in the affirmative.

As has been said above, the report of the International Joint Commission (1 (*g*)) contained a definition of the word "damage" excluding "occasional damage that may be caused by SO_2 fumes being carried across the international boundary in air pockets or by reason of unusual atmospheric conditions", as far, at least, as the duty of the Smelter to reduce the presence of that gas in the air was concerned.

The correspondence between the two Governments during the interval between that report and the conclusion of the Convention shows that the problem thus raised was what parties had primarily in mind in drafting Question No. 2. Whilst Canada wished for the adoption of the report, the United States stated that it could not acquiesce in the proposal to limit consideration of damage to damage as defined in the report (letter of the Minister of the United States of America at Ottawa to the Secretary of State for External Affairs of the Dominion of Canada, January 30, 1934). The view was expressed that "so long as fumigations occur in the State of Wash-

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p. 4325); Dr. John Baldwin *v.* Mexico (Moore, International Arbitrations, pp. 3235-3240); Robert H. May *v.* Guatemala (Foreign Relations of the United States, 1900, p. 674); Salvador Commercial Company *v.* Guatemala (Foreign Relations of the United States, 1902. pp. 859-873).

ington with such frequency, duration and intensity as to cause injury", the conditions afforded "grounds of complaint on the part of the United States, regardless of the remedial works.... and regardless of the effect of those works" (same letter).

The first problem which arises is whether the question should be answered on the basis of the law followed in the United States or on the basis of international law. The Tribunal, however, finds that this problem need not be solved here as the law followed in the United States in dealing with the quasi-sovereign rights of the States of the Union, in the matter of air pollution, whilst more definite, is in conformity with the general rules of international law.

Particularly in reaching its conclusions as regards this question as well as the next, the Tribunal has given consideration to the desire of the high contracting parties "to reach a solution just to all parties concerned".

As Professor Eagleton puts in (*Responsibility of States in International Law*, 1928, p. 80): "A State owes at all times a duty to protect other States against injurious acts by individuals from within its jurisdiction." A great number of such general pronouncements by leading authorities concerning the duty of a State to respect other States and their territory have been presented to the Tribunal. These and many others have been carefully examined. International decisions, in various matters, from the Alabama case onward, and also earlier ones, are based on the same general principle, and, indeed, this principle, as such, has not been questioned by Canada. But the real difficulty often arises rather when it comes to determine what, *pro subjecta materie*, is deemed to constitute an injurious act.

A case concerning, as the present one does, territorial relations, decided by the Federal Court of Switzerland between the Cantons of Soleure and Argovia, may serve to illustrate the relativity of the rule. Soleure brought a suit against her sister State to enjoin use of a shooting establishment which endangered her territory. The court, in granting the injunction, said: "This right (sovereignty) excludes.... not only the usurpation and exercise of sovereign rights (of another State).... but also an actual encroachment which might prejudice the natural use of the territory and the free movement of its inhabitants." As a result of the decision, Argovia made plans for the improvement of the existing installations. These, however, were considered as insufficient protection by Soleure. The Canton of Argovia then moved the Federal Court to decree that the shooting be again permitted after completion of the projected improvements. This motion was granted. "The demand of the Government of Soleure", said the court, "that all endangerment be absolutely abolished apparently goes too far." The court found that all risk whatever had not been eliminated, as the region was flat and absolutely safe shooting ranges were only found in mountain valleys; that there was a federal duty for the communes to provide facilities for military target practice and that "no more precautions may be demanded for shooting ranges near the boundaries of two Cantons than are required for shooting ranges in the interior of a Canton". (R. O. 26 I, p. 450, 451; R. O. 41, I, p. 137; see D. Schindler, "The Administration of Justice in the Swiss Federal Court in Intercantonal Disputes", *American Journal of International Law*, Vol. 15 (1921), pp. 172-174.)

No case of air pollution dealt with by an international tribunal has been brought to the attention of the Tribunal nor does the Tribunal know of any such case. The nearest analogy is that of water pollution. But, here also, no decision of an international tribunal has been cited or has been found.

There are, however, as regards both air pollution and water pollution, certain decisions of the Supreme Court of the United States which may legitimately be taken as a guide in this field of international law, for it is reasonable to follow by analogy, in international cases, precedents established by that court in dealing with controversies between States of the Union or with other controversies concerning the quasi-sovereign rights of such States, where no contrary rule prevails in international law and no reason for rejecting such precedents can be adduced from the limitations of sovereignty inherent in the Constitution of the United States.

In the suit of the State of Missouri *v.* the State of Illinois (200 U.S. 496, 521) concerning the pollution, within the boundaries of Illinois, of the Illinois River, an affluent of the Mississippi flowing into the latter where it forms the boundary between that State and Missouri, an injunction was refused. "Before this court ought to intervene", said the court, "the case should be of serious magnitude, clearly and fully proved, and the principle to be applied should be one which the court is prepared deliberately to maintain against all considerations on the other side. (See Kansas *v.* Colorado, 185 U.S. 125.)" The court found that the practice complained of was general along the shores of the Mississippi River at that time, that it was followed by Missouri itself and that thus a standard was set up by the defendant which the claimant was entitled to invoke.

As the claims of public health became more exacting and methods for removing impurities from the water were perfected, complaints ceased. It is significant that Missouri sided with Illinois when the other riparians of the Great Lakes' system sought to enjoin it to desist from diverting the waters of that system into that of the Illinois and Mississippi for the very purpose of disposing of the Chicago sewage.

In the more recent suit of the State of New York against the State of New Jersey (256 U.S. 296, 309), concerning the pollution of New York Bay, the injunction was also refused for lack of proof, some experts believing that the plans which were in dispute would result in the presence of "offensive odors and unsightly deposits", other equally reliable experts testifying that they were confidently of the opinion that the waters would be sufficiently purified. The court, referring to Missouri *v.* Illinois, said: ".... the burden upon the State of New York of sustaining the allegations of its bill is much greater than that imposed upon a complainant in an ordinary suit between private parties. Before this court can be moved to exercise its extraordinary power under the Constitution to control the conduct of one State at the suit of another, the threatened invasion of rights must be of serious magnitude and it must be established by clear and convincing evidence."

What the Supreme Court says there of its power under the Constitution equally applies to the extraordinary power granted this Tribunal under the Convention. What is true between States of the Union is, at least, equally true concerning the relations between the United States and the Dominion of Canada.

In another recent case concerning water pollution (283 U.S. 473), the complainant was successful. The City of New York was enjoined, at the request of the State of New Jersey, to desist, within a reasonable time limit, from the practice of disposing of sewage by dumping it into the sea, a practice which was injurious to the coastal waters of New Jersey in the vicinity of her bathing resorts.

In the matter of air pollution itself, the leading decisions are those of the Supreme Court in the State of Georgia *v.* Tennessee Copper Company and

Ducktown Sulphur, Copper and Iron Company, Limited. Although dealing with a suit against private companies, the decisions were on questions cognate to those here at issue. Georgia stated that it had in vain sought relief from the State of Tennessee, on whose territory the smelters were located, and the court defined the nature of the suit by saying: "This is a suit by a State for an injury to it in its capacity of quasi-sovereign. In that capacity, the State has an interest independent of and behind the titles of its citizens, in all the earth and air within its domain."

On the question whether an injunction should be granted or not, the court said (206 U.S. 230):

> It (the State) has the last word as to whether its mountains shall be stripped of their forests and its inhabitants shall breathe pure air.... It is not lightly to be presumed to give up quasi-sovereign rights for pay and .... if that be its choice, it may insist that an infraction of them shall be stopped. This court has not quite the same freedom to balance the harm that will be done by an injunction against that of which the plaintiff complains, that it would have in deciding between two subjects of a single political power. Without excluding the considerations that equity always takes into account .... it is a fair and reasonable demand on the part of a sovereign that the air over its territory should not be polluted on a great scale by sulphurous acid gas, that the forests on its mountains, be they better or worse, and whatever domestic destruction they may have suffered, should not be further destroyed or threatened by the act of persons beyond its control, that the crops and orchards on its hills should not be endangered from the same source.... Whether Georgia, by insisting upon this claim, is doing more harm than good to her own citizens, is for her to determine. The possible disaster to those outside the State must be accepted as a consequence of her standing upon her extreme rights.

Later on, however, when the court actually framed an injunction, in the case of the Ducktown Company (237 U.S. 474, 477) (an agreement on the basis of an annual compensation was reached with the most important of the two smelters, the Tennessee Copper Company), they did not go beyond a decree "adequate to diminish materially the present probability of damage to its (Georgia's) citizens".

Great progress in the control of fumes has been made by science in the last few years and this progress should be taken into account.

The Tribunal, therefore, finds that the above decisions, taken as a whole, constitute an adequate basis for its conclusions, namely, that, under the principles of international law, as well as of the law of the United States, no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence.

The decisions of the Supreme Court of the United States which are the basis of these conclusions are decisions in equity and a solution inspired by them, together with the régime hereinafter prescribed, will, in the opinion of the Tribunal, be "just to all parties concerned", as long, at least, as the present conditions in the Columbia River Valley continue to prevail.

Considering the circumstances of the case, the Tribunal holds that the Dominion of Canada is responsible in international law for the conduct of the Trail Smelter. Apart from the undertakings in the Convention, it is,

therefore, the duty of the Government of the Dominion of Canada to see to it that this conduct should be in conformity with the obligation of the Dominion under international law as herein determined.

The Tribunal, therefore, answers Question No. 2 as follows: (2) So long as the present conditions in the Columbia River Valley prevail, the Trail Smelter shall be required to refrain from causing any damage through fumes in the State of Washington; the damage herein referred to and its extent being such as would be recoverable under the decisions of the courts of the United States in suits between private individuals. The indemnity for such damage should be fixed in such manner as the Governments, acting under Article XI of the Convention, should agree upon.

PART FOUR.

The third question under Article III of the Convention is as follows: "In the light of the answer to the preceding question, what measures or régime, if any, should be adopted and maintained by the Trail Smelter?"

Answering this question in the light of the preceding one, since the Tribunal has, in its previous decision, found that damage caused by the Trail Smelter has occurred in the State of Washington since January 1, 1932, and since the Tribunal is of opinion that damage may occur in the future unless the operations of the Smelter shall be subject to some control, in order to avoid damage occurring, the Tribunal now decides that a régime or measure of control shall be applied to the operations of the Smelter and shall remain in full force unless and until modified in accordance with the provisions hereinafter set forth in Section 3, Paragraph VI of the present part of this decision.

SECTION 1.

The Tribunal in its previous decision, deferred the establishment of a permanent régime until more adequate knowledge had been obtained concerning the influence of the various factors involved in fumigations resulting from the operations of the Trail Smelter.

For the purpose of administering an experimental period, to continue to a date not later than October 1, 1940, during which studies could be made of the meteorological conditions in the Columbia River Valley, and of the extension and improvements of the methods for controlling smelter operations in closer relation to such meteorological conditions, the Tribunal, as said before, appointed two Technical Consultants, who directed the observations, experiments and operations through the remainder of the crop-growing season of 1938, the crop-growing seasons of 1939 and 1940 and the winter seasons of 1938-1939 and 1939-1940. The Tribunal appointed as Technical Consultants the two scientists who had been designated by the Governments to assist the Tribunal, Dr. R. S. Dean and Professor R. E. Swain.

The previous decision directed that during the trial period, a consulting meteorologist, to be appointed with the approval of the Technical Consultants, should be employed by the Trail Smelter. On May 4, 1938, Dr. J. Patterson was thus appointed. On May 1, 1939, Dr. Patterson resigned to take up meteorological service in the Canadian Air Force, and Dr. E. W. Hewson was given leave from the Dominion Meteorological Service and appointed in his stead.

The previous decision further directed the installation, operation and maintenance of such observation stations, of such equipment at the stacks and of such sulphur dioxide recorders (the permanent recorders not to exceed three in number) as the Technical Consultants would deem necessary.

The Technical Consultants were empowered to require regular reports from the Trail Smelter as to the methods of operation of its plant and the latter was to conduct its smelting operations in conformity with the directions of the Technical Consultants and of the Tribunal; these instructions could and, in fact, were modified from time to time on the result of the data obtained.

As further provided in the previous decision, the Technical Consultants regularly reported to the Tribunal which, as said before, met in 1939 to consult verbally with them about the temporary régime.

The previous decision finally prescribed that the Dominion of Canada should undertake to provide for the payment of the expenses resulting from this temporary régime.

On May 4, 1938, the Tribunal authorized and directed the employment of Dr. John P. Nielsen, an American citizen, engaged for three years in post-graduate work at Stanford University, in chemistry and plant physiology, as an assistant to the Technical Consultants; Dr. Nielsen continued in this capacity until October 1, 1938.

Through the authority vested in it by the Tribunal, this technical staff was enabled to study the influence of meteorological conditions on dispersion of the sulphurous gases emitted from the stacks of the smelter. This involved the establishment, operation, and maintenance of standard and newly designed meteorological instruments and of sulphur-dioxide recorders at carefully chosen localities in the United States and the Dominion of Canada, and the design and construction of portable instruments of various types for the observation of conditions at numerous surface locations in the Columbia River Valley and in the atmosphere over the valley. Observations on height, velocity, temperature, sulphur dioxide content, and other characteristics of the gas-carrying air currents, were made with the aid of captive balloons, pilot balloons and airplane flights. These observations were begun in May, 1938, and after information as to the inter-relation between meteorological conditions and sulphur-dioxide distribution had been obtained, the observations were continued throughout several experimental régimes of smelter operation during 1939 and 1940.

Periodic examination of crops and timber in the area claimed to be affected were made at suitable times by members of the technical staff.

The full details of the projects undertaken, the methods of study used, and the results obtained may be found in the final report entitled *Meteorological Investigations near Trail, B.C.*, 1938-1940, *by Reginald S. Dean and Robert E. Swain* (an elaborate document of 374 pages accompanied by numerous scientific charts, graphs and photographs, copies of which have been filed with the two Governments and have been made a part of the record by the Tribunal).

The Tribunal expresses the hope that the two Governments may see fit to make this valuable report available to scientists and smelter operators generally, either by printing or other form of reproduction.

SECTION 2.

(*a*)

The investigations during the experimental period make it clear that in the carrying out of a régime, automatic recorders should be located and maintained for the purpose of aiding in control of the emission of fumes at the Smelter and to provide data for observation of the effect of the controls on fumigations.

The investigations carried out by the Technical Consultants have confirmed the idea that the dissipation of the sulphur dioxide gas emitted from the Smelter takes place by eddy-current diffusion. The form of the attenuation curve for sulphur dioxide with distance from the Smelter is, therefore, determined by this mechanism of gas dispersion.

Analysis of the recorder data collected since May, 1938, confirms the conclusion of the Tribunal stated in its previous decision to the effect that "the concentration of sulphur dioxide falls off very rapidly from Trail to a point about 16 miles downstream from the Smelter, or 6 miles from the boundary line, measured by the general course of the river; and that at distances beyond this point, the concentration of sulphur-dioxide is lower and falls off more gradually and less rapidly". The position of the knee in this attenuation curve is somewhat affected by wind velocity and direction, and by other factors.

From an examination of the recorded data, it appears that the Columbia Gardens recorder located 6 miles below the Smelter, is above the knee of the attenuation curve. The Waneta recorder, 10 miles below the Smelter, is still in the region of very rapid decrease of sulphur dioxide while the Northport recorder, 19 miles below the Smelter, is well below the knee of the curve. There is very little variation in the average ratio of concentrations between the various recorders. For example, the average ratio for the years 1932 to 1935, between Columbia Gardens and Northport, was 1 to .31, while the average ratio for the experimental period from May, 1938, to November, 1940, was 1 to .39. The individual variations from this ratio are relatively small. The ratio between Columbia Gardens and Waneta for the period 1932 to 1935 was .6 and that for the period May 1938, to November 1940, was .75. The individual variations of the ratio between Columbia Gardens and Waneta are, however, much greater than those between Columbia Gardens and Northport. It is accordingly found that the Columbia Gardens recorder and the Northport recorder give as complete a picture of the attenuation of sulphur dioxide with distance as can be obtained with any reasonable number of recorders.

It may be fairly assumed that the sulphur dioxide concentration at Columbia Gardens will fall off quite rapidly with distance away from the Smelter, and that a concentration very close to that recorded at Northport will be reached several miles above Northport. Concentrations recorded at intermediate points are functions of a number of variables other than distance from the Smelter. It may be generally assumed that the concentration in the neighborhood of the border will be from .6 to .75 of that recorded at Columbia Gardens. Individual variations, however, are likely to be somewhat greater than this, and in unusual instances concentrations near the border may be substantially equal to those at Columbia Gardens.

Although as a result of the investigations carried out by the Technical Consultants, the conclusion might be warranted that the Waneta recorder could be discontinued, it has, nevertheless, been decided to have it main-

tained for a limited period of further investigations, particularly as it was removed from its present location during one winter season of the trial period. As an alternative to Waneta, a location suggested by the United States, Gunderson Farm (on the west bank of the river in Section 12, T. 40, R. 40), was considered. The difficulties inherent in servicing a recorder in that location, particularly in winter time, would not be compensated, it was thought, by any appreciable advantages. It was further considered that Waneta—a location practically identical to that of Boundary which the United States' scientists had selected in the past—jutting out as it does almost into the middle of the Columbia Valley where it swerves to the west, is one of the best sites that could be chosen for a recorder in that vicinity. The Tribunal, having gone into the matter with great care, is convinced that this choice is not adversely affected by the vicinity of the narrow gorge of the Pend-d'Oreille River.

(*b*)

The year is divided into two parts, which correspond approximately with the summer and winter seasons: *viz.*, the growing season which extends from April 1 through the summer to September 30, and the non-growing season which extends from October 1 through the winter to April 1. Atmospheric conditions in the Columbia River Valley during the summer vary widely from those in the winter. During the summer, or growing season, the air is generally in active movement with little tendency toward extended periods of calm, and smoke from the Smelter is rapidly dispersed by the frequent changes in wind direction and velocity and the higher degree of atmospheric turbulence. During the winter, or non-growing season, calm conditions may prevail for several days and smoke from the Smelter may be dispersed only very slowly.

In general, a similar variation in atmospheric stability occurs during the day. The air through the early morning hours until about nine o'clock is not subject to very rapid movement, but from around ten o'clock in the morning until late at night there is usually more wind and turbulence, with the exception of a quiet spell which often occurs during the late afternoon.

During the growing season, there is furthermore a marked diurnal variation of wind changes whose maximum frequency occurs at noon for the general direction from north to south and at seven o'clock in the evening for the general direction from south to north. This diurnal variation of wind changes does not occur so frequently during the non-growing season.

During the growing season, the descent of sulphur dioxide to the earth's surface is more likely to occur at some hours than at others. At about nine to ten o'clock in the morning, there is usually a very pronounced maximum of fumigations, and this morning fumigation occurs with such regularity that it has been the practice of the Smoke Control Office at the Smelter for some time to cut down the emission of sulphur to the atmosphere during the early morning hours and to keep it down until from eight to eleven o'clock in the morning. The amount and duration of the cut are determined after an analysis of the wind velocity and direction, and of the conditions of turbulence or diffusion of the smoke. This is a fundamental feature of the program of smoke control, and the main reason for its success is that it prevents accumulations of sulphur dioxide which tend to descend from higher elevations when the early morning sun disturbs the thermal balance by heating the earth's surface. This early morning diurnal fumigation reaches

all recorders in the valley almost simultaneously, the intensity being usually highest near the Smelter. The concentration of sulphur dioxide during this type of fumigation rises as a rule very rapidly to a maximum in a few minutes and then drops off exponentially, only traces often remaining after two or three hours. A similar diurnal fumigation, usually of shorter duration, is occasionally observed in the early evening due to a disturbance of the thermal balance as the sun sets.

Sulphur dioxide sampling by airplane has indicated that in calm weather and especially in the early morning hours, the effluent gases hold to a fairly well-defined pattern in the early stages of their dispersion. The gases rise about 400 feet above the top of the two high stacks, then level out and spread horizontally along the main axis of the prevailing wind movement. During the relatively quiet conditions frequently found in the early morning, an atmospheric stratum carrying fairly high concentrations of sulphur dioxide and spreading over a large area may be formed.

With the rising of the sun, the radiational heating of the atmosphere near the surface may disturb the thermal balance, resulting in the descent of the sulphur dioxide which had accumulated in the upper layers at approximately 2,400 feet elevation above mean sea level, and extending either up-stream or down-stream from the Smelter, depending on wind direction. This readily explains the simultaneous appearance of sulphur dioxide at various distances from the Smelter.

During the non-growing season, the non-diurnal type of fumigation predominates. In this type, the sulphur dioxide leaving the stacks is carried along the valley in a general drift of air, diffusing more or less uniformly as it advances. From two to eight hours are usually required for the smoke to get from Trail to Northport when the drift is down river. Such fumigations are not recorded simultaneously on the various recorders but the gas is first noted nearest the Smelter and then in succession at the other recorders. The concentration at a given recorder often shows very little variation as long as it lasts, which might be for several days depending entirely upon wind velocity and direction.

It is an interesting fact that the agricultural growing season and the non-growing season coincide almost exactly with the periods in which diurnal and non-diurnal fumigations respectively, are dominant. The transition from diurnal to non-diurnal fumigations and *vice versa* occurs in September and April. Diurnal fumigations sometimes occur during the non-growing season but with much less frequency and regularity than during the growing season, and at a later hour because of the later sunrise in winter. Similarly, the non-diurnal type sometimes occurs during the growing season. Its manifestations are then the same as during the winter, the chief difference being that it rarely lasts as long.

Sulphur dioxide recorders can be used to assist in smoke control during both the growing and non-growing season. They are more useful in the latter season, however, because in a non-diurnal fumigation, the gas usually appears at Columbia Gardens some time before it reaches Northport, and high concentrations recorded at the former location serve as warnings that more sulphur dioxide is being emitted than can adequately be dispersed under the prevailing atmospheric conditions. This information may lead to a decrease in the amount of sulphur dioxide emitted from the Smelter in time to avoid serious consequences. With the diurnal type of fumigations, on the other hand, high concentrations of sulphur dioxide may descend from the upper atmosphere to the surface with little or no warning, and the

only adequate protection against this type of fumigation is to prevent accumulations of large amounts of sulphur dioxide, either up or down stream, at or just before the periods when diurnal fumigations may be expected.

(*c*)

Observations over a period of years have indicated that there is little likelihood of gas being carried across the international boundary if the wind in the gas-carrying levels, approximately 2,400 feet above mean seal level, is in a direction not included in the 135° angle opening to the westward starting with north, and has a velocity sufficient to insure that no serious accumulation of smoke occurs. A recording cup anemometer and an anemovane suspended 300 feet above the surface, 1,900 feet above mean sea level, from a cable between the tops of the zinc stack and a neighboring lower stack, indicate the velocity and direction of the wind reliably except when the velocity or direction of the wind at this level differs from that in the gas-carrying level 500 feet or more higher. An attempt has been made to use the geostrophic wind forecasts made by the Weather Bureau at Vancouver for predicting the velocity and direction of the wind at these higher levels, but the results, although promising, have not yet been sufficiently certain to warrant the use of geostrophic winds as a factor in smoke control. (For further details, see Report of the Technical Consultants.)

(*d*)

A very significant factor in determining how much sulphur dioxide can safely be emitted by the Smelter is the rate of eddy current diffusion. When the rate of diffusion is low, smoke may accumulate in parts of the valley. Such accumulations frequently occur up-stream from the Smelter when there is a light up-river breeze.

The main factors governing the rate of diffusion of sulphur dioxide are the turbulence and lapse rate of the air. Turbulence is used instead of the more homely term gustiness to express the action of eddy currents in the air stream. Turbulence, therefore, is expressed in terms of changes in wind velocity over definite intervals of time, and may be measured by observations on standard anemometers, as has been done during the early stages of these meteorological studies. It has been found, however, that different observers using this method of measurement were not in agreement when the changes in velocity occurred rapidly and were of great intensity. It was furthermore found that the sensitivity of standard anemometers was not sufficient to give the desired precision. A number of modifications have been made which have led finally to the design and construction of an instrument called the Bridled Cup Indicator, which is more sensitive than any of the other instruments used, and is also free from personal error in the reading of the instrumental record.

(*e*)

There are several limitations to the application of the turbulence criterion. On a number of occasions, marked fumigations have occurred when the instrument showed that the turbulence was good or excellent. On every occasion of that sort which has been studied, pilot balloon observations revealed that there was a strong down-river wind from the surface of the

valley floor to about 2,500 feet above mean sea level. At about 4,000 feet, however, the height to which the valley sides reached, conditions were calm or very nearly so. Ordinarily, with good turbulence, the sulphur dioxide would be rapidly diffused upward and rise above the sides of the valley without difficulty. The non-turbulent condition at 4,000 feet associated with the calm layer acts effectively as a blanket, preventing the escape of the gas through the top of the valley. The turbulence in the lower layers serves then only to distribute the sulphur dioxide more or less uniformly in the valley. There is no exit through the top, and the gas moves down the valley with no lateral diffusion, in much the same way as if it were flowing along in a giant pipe. This type does not occur very frequently, but when it does, the sulphur dioxide recorder at Columbia Gardens must be used to prevent the building up of high concentrations in the valley. That is the type of fumigation which can be controlled most readily by means of such a recorder.

(*f*)

Another difficulty with the turbulence condition is that, especially during the daytime in summer, the turbulence recorder may indicate very little turbulence, but the diffusion may nevertheless be quite satisfactory. That is because turbulence does not cover all aspects of diffusion and some other factors, such as the lapse rate, must be taken into account.

Lapse rate, which is the technical term for the change of temperature in any given unit interval of height, is inter-related with wind velocity and turbulence, but each may contribute separately in the slow carrying upward of smoke by means of convection currents. Unfortunately, the measurement of lapse rate and its application in smoke control have not yet been fully developed. (For further details, see Final Report of the Technical Consultants.)

(*g*)

The behavior of the air in the valley is influenced also by other general meteorological conditions. For example, experience has shown that when the relative humidity of the air is high, particularly during periods of rain or snow, caution must be used in emitting sulphur dioxide to the atmosphere. Again, when the barometer is steady, weather conditions such as wind direction and velocity, diffusion conditions, etc., are not liable to change. Similarly, unfavorable conditions are likely to persist until the barometer changes noticeably. This suggests a generalization which will be found to hold not only for barometric changes but also for most of the other factors that have been found to influence sulphur dioxide distribution; that fumigations occur chiefly during the period of disturbance that accompanies transitional stages in meteorological conditions.

(*h*)

It has been found by the Technical Consultants that meteorological conditions at the Smelter sometimes prevail under which the instrumental readings at the level where the instruments now are or may be located do not fully reflect the degree of turbulence in the atmosphere at the higher gas-carrying levels. Under those conditions, it is possible that visual observations by trained observers may sometimes determine the turbulence more accurately. Where by such visual observations the conclusion shall be

reached that the turbulence at higher levels is definitely better than at the level of the instruments, the load can sometimes be safely increased from the maximum allowable as determined by the instruments under the régime herein prescribed. Conversely, where by such visual observations the conclusion shall be reached that the turbulence at higher levels is definitely worse than at the level of the instruments, it will be the duty of the Smelter (and to its advantage in lessening risk of injurious fumigation) to reduce the load from the maximum allowable as determined by the instruments under the régime herein prescribed.

The Tribunal in the régime has taken into consideration this factor of visual observations, to a limited extent and in the non-growing season only. If further experience shall show in the future that more use can be made of this factor, the clause of the régime providing for a method of its alteration may be utilized for a future development of this factor provided it shall appear that it can be done without risk of injury to territory south of the boundary.

(*i*)

The Tribunal is of opinion that the régime should be given an uninterrupted test through at least two growing periods and one non-growing period. It is equally of opinion that thereafter opportunity should be given for amendment or suspension of the régime, if conditions should warrant or require. Should it appear at any time that the expectations of the Tribunal are not fulfilled, the régime prescribed in Section 3 (*infra*) can be amended according to Paragraph VI thereof. This same paragraph may become operative if scientific advance in the control of fumes should make it possible and desirable to improve upon the methods of control hereinafter prescribed; and should further progress in the reduction of the sulphur content of the fumes make the régime, as now prescribed, appear as unduly burdensome in view of the end defined in the answer to Question No. 2, this same paragraph can be invoked in order to amend the régime accordingly. Further, under this paragraph, the régime may be suspended if the elimination of sulphur dioxide from the fumes should reach a stage where such a step could clearly be taken without undue risks to the United States' interests.

Since the Tribunal has the power to establish a régime, it must equally possess the power to provide for alteration, modification or suspension of such régime. It would clearly not be a "solution just to all parties concerned" if its action in prescribing a régime should be unchangeable and incapable of being made responsive to future conditions.

(*j*)

The foregoing paragraphs are the result of an extended investigation of meteorological and other conditions which have been found to be of significance in smoke behavior and control in the Trail area. The attempt made to solve the sulphur dioxide problem presented to the Tribunal has finally found expression in a régime which is now prescribed as a measure of control.

The investigations made during the past three years on the application of meteorological observations to the solution of this problem at Trail have built up a fund of significant and important facts. This is probably the most thorough study ever made of any area subject to atmospheric pollution by industrial smoke. Some factors, such as atmospheric turbulence and

the movement of the upper air currents have been applied for the first time to the question of smoke control. All factors of possible significance, including wind directions and velocity, atmospheric temperatures, lapse rates, turbulence, geostrophic winds, barometric pressures, sunlight and humidity, along with atmospheric sulphur dioxide concentrations, have been studied. As said above, many observations have been made on the movements and sulphur dioxide concentrations of the air at higher levels by means of pilot and captive balloons and by airplane, by night and by day. Progress has been made in breaking up the long winter fumigations and in reducing their intensity. In carrying finally over to the non-growing season with a few minor modifications a régime of demonstrated efficiency for the growing season, there is a sound basis for confidence that the winter fumigations will be kept under control at a level well below the threshold of possible injury to vegetation. Likewise, for the growing season a régime has been formulated which should throttle at the source the expected diurnal fumigations to a point where they will not yield concentrations below the international boundary sufficient to cause injury to plant life. This is the goal which this Tribunal has set out to accomplish.

The Tribunal has carefully considered the suggestions made by the United States for a régime by which a prefixed sum would be due whenever the concentrations recorded would exceed a certain intensity for a certain period of time or a certain greater intensity for any twenty minute period.

It has been unable to adopt this suggestion. In its opinion, and in that of its scientific advisers, such a régime would unduly and unnecessarily hamper the operations of the Trail Smelter and would not constitute a "solution fair to all parties concerned".

SECTION 3.

In order to prevent the occurrence of sulphur dioxide in the atmosphere in amounts, both as to concentration, duration and frequency, capable of causing damage in the State of Washington, the operation of the Smelter and the maximum emission of sulphur dioxide from its stacks shall be regulated as provided in the following régime.

I. Instruments.

A. The instruments for recording meteorological conditions shall be as follows:

(*a*) Wind Direction and Wind Velocity shall be indicated by any of the standard instruments used for such purposes to provide a continuous record and shall be observed and transcribed for use of the Smoke Control Office at least once every hour.

(*b*) Wind Turbulence shall be measured by the Bridled Cup Turbulence Indicator. This instrument consists of a light horizontal wheel around whose periphery are twenty-two equally-spaced curved surfaces cut from one-eighth inch aluminium sheet and shaped to the same-sized blades or cups. This wind-sensitive wheel is attached to an aluminium sleeve rigidly screwed to one end of a three-eighth inch vertical steel shaft supported by almost frictionless bearings at the top and bottom of the instrument frame. The shaft of the wheel is bridled to prevent continuous rotation and is so

constrained that its angle of rotation is directly proportional to the square of the wind velocity. One complete revolution of the anemometer shaft corresponds to a wind velocity of 36 miles per hour and, with eighteen equally spaced contact points on the commutator, one make and one break in the circuit is equivalent to a change in wind velocity of two miles per hour, recorded on a standard anemograph. (For further detail, see the Final Report of the Technical Consultants, p 209.)

The instruments noted in (*a*) and (*b*) above, shall be located at the present site near the zinc stack of the Smelter or at some other location not less favorable for such observations.

(*c*) Atmospheric temperature and barometric pressure shall be determined by the standard instruments in use for such meteorological observations.

B. Sulphur dioxide concentrations shall be determined by the standard recorders, which provide automatically an accurate and continuous record of such concentrations.

One recorder shall be located at Columbia Gardens, as at present installed with arrangements for the automatic transcription of its record to the Smoke Control Office at the Smelter. A second recorder shall be maintained at the present site near Northport. A third recorder shall be maintained at the present site near Waneta, which recorder may be discontinued after December 31, 1942.

II. Documents.

The sulphur dioxide concentrations indicated by the prescribed recorders shall be reduced to tabular form and kept on file at the Smelter. The original instrumental recordings of all meteorological data herein required to be made shall be preserved by the Smelter.

A summary of Smelter operation covering the daily sulphur balances shall be compiled monthly and copies sent to the Governments of the United States and of the Dominion of Canada.

III. Stacks.

Sulphur dioxide shall be discharged into the atmosphere from smelting operations of the zinc and lead plants at a height no lower than that of the present stacks.

In case of the cooling of the stacks by a lengthy shut down, gases containing sulphur dioxide shall not be emitted until the stacks have been heated to normal operating temperatures by hot gases free of sulphur dioxide.

IV. Maximum Permissible Sulphur Emission.

The following two tables and general restrictions give the maximum hourly permissible emission of sulphur dioxide expressed as tons per hour of contained sulphur.

GROWING SEASON

	Turbulence Bad		Turbulence Fair		Turbulence Good		Turbulence Excellent
	(1) Wind not favorable	(2) Wind favorable	(3) Wind not favorable	(4) Wind favorable	(5) Wind not favorable	(6) Wind favorable	(7) Wind not favorable and favorable
Midnight to 3 a.m. . .	2	6	6	9	9	11	11
3 a.m. to 3 hrs. after sunrise	0	2	4	4	4	6	6
3 hrs. after sunrise to 3 hrs. before sunset	2	6	6	9	9	11	11
3 hrs. before sunset to sunset	2	5	5	7	7	9	9
Sunset to midnight . .	3	7	6	9	9	11	11

NON-GROWING SEASON

	Turbulence Bad		Turbulence Fair		Turbulence Good		Turbulence Excellent
	(1) Wind not favorable	(2) Wind favorable	(3) Wind not favorable	(4) Wind favorable	(5) Wind not favorable	(6) Wind favorable	(7) Wind not favorable and favorable
Midnight to 3 a.m. . .	2	8	6	11	9	11	11
3 a.m. to 3 hrs. after sunrise	0	4	4	6	4	6	6
3 hrs. after sunrise to 3 hrs. before sunset	2	8	6	11	9	11	11
3 hrs. before sunset to sunset	2	7	5	9	7	9	9
Sunset to midnight . .	3	9	6	11	9	11	11

General Restrictions and Provisions.

(*a*) If the Columbia Gardens recorder indicates 0.3 part per million or more of sulphur dioxide for two consecutive twenty minute periods during the growing season, and the wind direction is not favorable, emission shall be reduced by four tons of sulphur per hour or shut down completely when the turbulence is bad, until the recorder shows 0.2 part per million or less of sulphur dioxide for three consecutive twenty minute periods.

If the Columbia Gardens recorder indicates 0.5 part per million or more of sulphur dioxide for three consecutive twenty minute periods during the non-growing season and the wind direction is not favorable, emission shall be reduced by four tons of sulphur per hour or shut down completely when the turbulence is bad, until the recorder shows 0.2 part per million or less of sulphur dioxide for three consecutive twenty minute periods.

(*b*) In case of rain or snow, the emission of sulphur shall be reduced by two (2) tons per hour. This regulation shall be put into effect immediately when precipitation can be observed from the Smelter and shall be continued in effect for twenty (20) minutes after such precipitation has ceased.

(*c*) If the slag retreatment furnace is not in operation the emission of sulphur shall be reduced by two (2) tons per hour.

(*d*) If the instrumental reading shows turbulence excellent, good or fair, but visual observations made by trained observers clearly indicate that there is poor diffusion, the emission of sulphur shall be reduced to the figures given in column (1) if wind is not favorable, or column (2) if wind is favorable.

(*e*) When more than one of the restricting conditions provided for in (*a*), (*b*), (*c*), and (*d*) occur simultaneously, the highest reduction shall apply.

(*f*) If, during the non-growing season, the instrumental reading shows turbulence fair and wind not favorable but visual observations by trained observers clearly indicate that there is excellent diffusion, the maximum permissible emission of sulphur may be increased to the figures in column (5). The general restrictions under (*a*), (*b*), (*c*) and (*e*), however, shall be applicable.

Whenever the Smelter shall avail itself of the foregoing provisions, the circumstances shall be fully recorded and copy of such record shall be sent to the two Governments within one month.

(*g*) Nothing shall relieve the Smelter from the duty of reducing the maximum sulphur emission below the amount permissible according to the tables and the preceding general restrictions and provisions, as the circumstances may require for the prudent operation of the plant.

V. Definition of Terms and Conditions

(a) Wind Direction and Velocity—The following directions of wind shall be considered favorable provided they show a velocity of five miles per hour or more and have persisted for thirty minutes at the point of observation, namely north, east, south, southwest, and intermediate directions, that is any direction not included in the one hundred and thirty-five (135) degree angle opening to the westward starting with north.

All winds not included in the above definition shall be considered not favorable.

(b) Turbulence—The following definitions are made of bad, fair, good, and excellent turbulence. The figures given are in terms of the Bridled Cup Turbulence Indicator for a period of one half hour:

Bad Turbulence	0-74
Fair Turbulence	75-149
Good Turbulence	150-349
Excellent Turbulence	350 and above

If at any time another instrument should be found to be better adapted to the measurement of turbulence, and should be accepted for such measure-

ment by agreement of the two Governments, the scale of this instrument shall be calibrated by comparison with the Bridled Cup Turbulence Indicator.

VI. Amendment or Suspension of the Régime.

If at any time after December 31, 1942, either Government shall request an amendment or suspension of the régime herein prescribed and the other Government shall decline to agree to such request, there shall be appointed by each Government, within one month after the making or receipt respectively of such request, a scientist of repute; and the two scientists so appointed shall constitute a Commission for the purpose of considering and acting upon such request. If the Commission within three months after appointment fail to agree upon a decision, they shall appoint jointly a third scientist who shall be Chairman of the Commission; and thereupon the opinion of the majority, or in the absence of any majority opinion, the opinion of the Chairman shall be decisive; the opinion shall be rendered within one month after the choice of the Chairman. If the two scientists shall fail to agree upon a third scientist within the prescribed time, upon the request of either, he shall be appointed within one month from such failure by the President of the American Chemical Society, a scientific body having a membership both in the United States, Canada, Great Britain and other countries.

Any of the periods of time herein prescribed may be extended by agreement between the two Governments.

The Commission of two, or three scientists as the case may be, may take such action in compliance with or in denial of the request above referred to, either in whole or in part, as it deems appropriate for the avoidance or prevention of damage occurring in the State of Washington. The decision of the Commission shall be final, and the Governments shall take such action as may be necessary to ensure due conformity with the decision, in accordance with the provisions of Article XII of the Convention.

The compensation of the scientists appointed and their reasonable expenditures shall be paid by the Government which shall have requested a decision; if both Governments shall have made a request for decision, such expenses shall be shared equally by both Governments; provided, however, that if the Commission in response to the request of the United States shall find that notwithstanding compliance with the régime in force damage has occurred through fumes in the State of Washington, then the above expenses shall be paid by the Dominion of Canada.

SECTION 4.

While the Tribunal refrains from making the following suggestion a part of the régime prescribed, it is strongly of the opinion that it would be to the clear advantage of the Dominion of Canada, if during the interval between the date of filing of this Final Report and December 31, 1942, the Dominion of Canada would continue, at its own expense, the maintenance of experimental and observational work by two scientists similar to that which was established by the Tribunal under its previous decision, and has been in operation during the trial period since 1938. It seems probable that a continuance of investigations until at least December 31, 1942, would provide additional valuable data both for the purpose of testing the effective operation of the régime now prescribed and for the purpose of obtaining information as to the possibility or necessity of improvements in it.

The value of this trial period has been acknowledged by each Government. In the memorandum submitted by the Canadian Agent, under date of December 28, 1940, while commenting on the expense involved, it is stated (p. 8):

> The Canadian Government is not disposed to question in the least the value of the trial period of three years or to underestimate the great benefits that have been derived from the investigations carried on by the Tribunal through its Technical Consultants.

The Agent for Canada at the hearing on December 11, 1940 (Transcript, p. 6318) stated:

> We have had the benefit of an admirable piece of research in fumigations conducted by the Technical Consultants, and we have had the advantage of all of their studies of meteorological conditions. . . .

The Counsel for Canada (Mr. Tilley), in a colloquy with the American Member of the Tribunal at the hearing on December 12, 1940 (Transcript, pp. 6493-6494) said:

> JUDGE WARREN: We stated very frankly to the Agents that we were prepared in March (1938) to render a final decision but that we thought it would be highly unsatisfactory to both parties to do so unless we had some experimentation.
>
> Mr. TILLEY: There is no doubt about that—quite properly, if I may say so, with deference.
>
> JUDGE WARREN: We were trying to do this for the benefit of both parties. We were prepared to answer the questions.
>
> Mr. TILLEY: Nothing could have been more in the interests of the parties concerned than what you did.

In the memorandum submitted by the United States Agent, under date of January 7, 1949, while explaining the reasons for the inability of the United States to offer concrete suggestions in relation to a proposed régime, other than the régime suggested by the United States, it is stated (p. 11):

> It should be understood that the drafting of this Memorandum has not been undertaken in an attempt to minimize the importance of the excellent work performed by meteorologists of the Government of Canada under the direction of the Technical Consultants and their undoubtedly meritorious contribution. . . .

The Counsel for the United States (Mr. Raftis) at the hearing on December 9, stated (Transcript of Record, p. 6080, p. 6089):

> I will say at the outset that I believe the meteorological studies which we (were?) conducted have been very helpful. They have been undoubtedly gone into at considerable length with a definite effort to put the finger on the problem which has been confronting us now for some fifteen years. . . . As I say, I think these studies have been most helpful, because up to that time we had more or less only to leave to conjecture what happened when these gases left the stacks; we did not know through any definite experiments what became of this gas problem.

The scientist employed by the United States, Mr. S. W. Griffin, in his report submitted November 30, 1940, relating to the Final Report of the Technical Consultants, stated (p. 3):

> Regarding the investigations of the Canadian meteorologists in working out the complicated air movements which take place over this irregular terrain, there can be no doubt of the value of their contribution in adding much to the knowledge, both of a fundamental and detailed character, to that which previously existed.
>
> (p. 5) It remains to be determined whether or not the three year period of experimentation may eventually bring about a permanent abeyance of harmful sulphur dioxide fumigations, south of the international boundary. However this may be, there can be little doubt that the knowledge gained in some of the researches described in the report is sufficiently fundamental in character and broad in application that, if published, the work should be of interest and value to any smelter management engaged in processes which pollute the air with sulphur dioxide.

PART FIVE.

The fourth question under Article III of the Convention is as follows:

> What indemnity or compensation, if any, should be paid on account of any decision or decisions rendered by the Tribunal pursuant to the next two preceding Questions?

The Tribunal is of opinion that the prescribed régime will probably remove the causes of the present controversy and, as said before, will probably result in preventing any damage of a material nature occurring in the State of Washington in the future.

But since the desirable and expected result of the régime or measure of control hereby required to be adopted and maintained by the Smelter may not occur, and since in its answer to Question No. 2, the Tribunal has required the Smelter to refrain from causing damage in the State of Washington in the future, as set forth therein, the Tribunal answers Question No. 4 and decides that on account of decisions rendered by the Tribunal in its answers to Question No. 2 and Question No. 3 there shall be paid as follows: (*a*) if any damage as defined under Question No. 2 shall have occurred since October 1, 1940, or shall occur in the future, whether through failure on the part of the Smelter to comply with the regulations herein prescribed or notwithstanding the maintenance of the régime, an indemnity shall be paid for such damage but only when and if the two Governments shall make arrangements for the disposition of claims for indemnity under the provisions of Article XI of the Convention; (*b*) if as a consequence of the decision of the Tribunal in its answers to Question No. 2 and Question No. 3, the United States shall find it necessary to maintain in the future an agent or agents in the area in order to ascertain whether damage shall have occurred in spite of the régime prescribed herein, the reasonable cost of such investigations not in excess of $7,500 in any one year shall be paid to the United States as a compensation, but only if and when the two Governments determine under Article XI of the Convention that damage has occurred in the year in question, due to the operation of the Smelter, and "disposition of claims for indemnity for damage" has been made by the two Governments; but in no case shall the aforesaid compensation be payable in excess of the indemnity

for damage; and further it is understood that such payment is hereby directed by the Tribunal only as a compensation to be paid on account of the answers of the Tribunal to Question No. 2 and Question No. 3 (as provided for in Question No. 4) and *not* as any part of indemnity for the damage to be ascertained and to be determined upon by the two Governments under Article XI of the Convention.

PART SIX.

Since further investigations in the future may be possible under the provisions of Part Four and of Part Five of this decision, the Tribunal finds it necessary to include in its report, the following provision:

Investigators appointed by or on behalf of either Government, whether jointly or severally, and the members of the Commission provided for in Paragraph VI of Section 3 of Part Four of this decision, shall be permitted at all reasonable times to inspect the operations of the Smelter and to enter upon and inspect any of the properties in the State of Washington which may be claimed to be affected by fumes. This provision shall also apply to any localities where instruments are operated under the present régime or under any amended régime. Wherever under the present régime or any amended régime, instruments have to be maintained and operated by the Smelter on the territory of the United States, the Government of the United States shall undertake to secure for the Government of the Dominion of Canada the facilities reasonably required to that effect.

The Tribunal expresses the strong hope that any investigations which the Governments may undertake in the future, in connection with the matters dealt with in this decision, shall be conducted jointly.

(*Signed*) JAN HOSTIE.
(*Signed*) CHARLES WARREN.
(*Signed*) R. A. E. GREENSHIELDS.

ANNEX.

I. *Letter from the Members of the Tribunal to the Secretary of State of the United States and Secretary of State for External Affairs of Canada, May* 6, 1941.

TRAIL SMELTER ARBITRAL TRIBUNAL.
UNITED STATES AND CANADA.

710 MILLS BUILDING,
WASHINGTON, D.C.
May 6, 1941.

SIR:

The Trail Smelter Arbitral Tribunal has received from its scientific advisers in that case, a letter dated April 28, 1941, copy of which is herewith enclosed. The members of the Tribunal think that it is their duty in transmitting this letter to both Governments, to declare that the statement contained therein is the correct interpretation of Clause IV, Section 3 of Part Four of the Decision reported on March 11, 1941.

Respectfully yours,

JAN HOSTIE.
CHARLES WARREN.
R. A. E. GREENSHIELDS.

II. *Letter from the Technical Consultants to the Chairman of the Trail Smelter Arbitral Tribunal, April* 26, 1941.

REGINALD S. DEAN.

1529 ARLINGTON DRIVE,
SALT LAKE CITY, UTAH,
April 28, 1941.

DR. JAN F. HOSTIE,
Trail Smelter Arbitral Tribunal,
710 Mills Building,
Washington, D.C.

DEAR DOCTOR HOSTIE:

A critical reading of the text of Part IV, Section 3 (IV) of the decision of the Tribunal reported on March 11, 1941, reveals a situation which, after careful consideration, we feel should be brought to your attention. Under the heading "Maximum Permissible Sulphur Emission" it is stated that the two tables and the general restrictions which follow give the maximum hourly permissible emission of sulphur dioxide expressed as tons per hour of contained sulphur.

If a strict interpretation were placed on this statement as it stands, it would lead often to a complete shut-down of all operations at the Smelter. For example, if the turbulence is bad and the wind not favorable, no sulphur may be emitted. Of course, it was intended that these stipulations were to govern Dwight and Lloyd roasting operations. Small amounts of sulphur dioxide will necessarily escape from the blast furnace and other operations in the Smelter, but these have never been specifically designated in any of the régimes which we have laid down, simply because they are insignificant in amount. In the orderly administration of this final régime, all who have been connected with the previous régimes would not fall within the above stipulation. If, however, the strictest possible interpretation were insisted upon the results would not only be disastrous to the Smelter, but clearly outside of the intended scope of the régime. Tail gases have been recognized all along as a normal part of the smelting operation.

The situation would be fully clarified if the following changes were made in the statement on page 74, Section 3 (IV): The following two tables and general restrictions give the maximum hourly permissible emission of untreated sulphur dioxide from the roasting plants expressed as tons per hour of contained sulphur.

I regret that such a possible interpretation of the régime was not noted by us when it was being formulated. It is brought to your attention now in order to put on record this possible misinterpretation of the régime as it is now worded.

Yours sincerely,

ROBERT E. SWAIN,
R. S. DEAN,
Technical Consultants.