extent, there has been some question whether it is possible to obtain asci homozygous for this factor. These experiments prove that occasionally ascocarps in which the asci are homozygous, II, for the lethal can be obtained. Another question arises as to whether interspecific crosses can be made when one of the parents carries this factor I. When *Neurospora tetrasperma,* the 4-spored species, carrying the lethal, I, is mated against *Neurospora sitophila,* the 8-spored species, the resulting asci so far obtained have been 8-spored, as might be expected because 8-sporedness is dominant over 4-sporedness. Some evidence had previously been obtained to indicate that this factor may revert or lose its power altogether to bring about abortion in heterozygous, Ii, asci. When the lethal was introduced in these interspecific crosses it was not effective in bringing about indurated ascus abortion in the first generation in these experiments.

(To be concluded)

PLACER MINING AND THE ANADROMOUS FISH OF THE ROGUE RIVER

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THE wide-spread pollution of streams and lakes in the United States is well known and recognized not only by all students of natural history but by many others whose love of nature and contact with existing conditions have made them painfully conscious of the situation. The demand for correction or limitation of these conditions is based on the damage done to water supplies essential for the population in given areas, on the destruction of fish life and other aquatic organisms, both plant and animal, that play an essential part in the economy of nature, and on the serious limitation or total destruction of recreational opportunities connected with the water bodies involved.

Abundant evidence has been secured in specific cases to justify the complaints and to call for corrective legislation. The protection of drinking water supplies is generally acknowledged to be essential. Scientific studies have definitely connected the destruction of the fish life with the dumping of manufacturing wastes into various rivers or the discharge of large volumes of domestic waste in untreated sewage. Even before the condition of the water had become so marked as to deter adults or youths from utilizing streams or lakes for recreation, health boards had interdicted such practices on the basis of demonstrated contamination of the water. Increasing volumes of polluted water have become of such national concern that the last Congress devoted much time to the discussion of the problem, although unfortunately the emasculated measure adopted at the last moment was generally unsatisfactory and wisely vetoed by the President. One new phase in the relation between the fish fauna and the environmental conditions it encounters in a particular locality has been subjected to careful study with reference to a factor which appears not to have been investigated previously.

In many places the fish supply of our rivers constitutes a natural resource of high value, though often overlooked and sadly neglected. Recently attention has been directed to the influence of local practises on the welfare of the fish in the stream. The Rogue River in southwestern Oregon has long been famous for its steelhead and salmon. Within recent years the run of these fish has fallen off materially, and some have attributed the decline to an increased activity in placer mining which adds to the stream a considerable volume of earthy material washed down from the hillsides of the valley. On the other hand, the gold-bearing soils constitute a valuable natural resource, the development of which has contributed materially to the welfare of the area and of the state. This conflict of interests led to legal controversy in which the need for more accurate determintaion of the facts involved became evident.

I was asked to make an independent and all-sided study of the river in order to ascertain the accuracy of the complaint, the extent and character of any damage done to the fish, and when the damage was determined to consider how the placer mining industry might modify its practises for the protection of the fish. I was assured of perfect freedom in carrying out my studies and in publishing the results. The report[1] just completed contains some biological observations of such character as to justify their presentation here in brief.

The charge brought against the placer mining industry maintained that it discharged into the river an amount of waste inimical to the welfare of the fish. No one doubted that during the active season the run-off from placer mining added to the stream a considerable amount of silt and that material in miners' terminology was "waste." Superficial inspection had convinced people generally that the stream "looked bad," but in the complaint no real evidence was offered as to the effects on the fish. The rusty-red, muddy

[1] "Placer Mining on the Rogue River, Oregon, in its Relation to the Fish and Fishing in that Stream. An ecological study made for the Oregon State Department of Geology and Mineral Industries." Bull. No. 10.

water made so unfavorable an impression on the observer that it seemed to justify the complaint. Indeed, at the start I was inclined to regard conditions as at least somewhat unfavorable for the fish.

The question of fundamental importance is to determine what kinds of material are actually dangerous or destructive and as such should be rigorously prohibited from discharge in untreated condition. On the other hand, it is clear that with every rainstorm large quantities of earthy matter from fields, hillsides and forests are washed into the stream and serve to increase the natural load picked up by the waters in their normal course through the land. In many regions the quantity of material normally carried by a stream is large, and its character such that some part remains in suspension almost indefinitely.

The magnitude of this load is well indicated by Table 1, which cites data of normal turbidity in various streams not subject to the influence of mining, as recorded by various agencies. The Oregon streams are moderately loaded; the last two rivers represent extreme conditions.

TABLE 1

AMOUNT OF SILT CARRIED BY CERTAIN RIVERS

	Parts per million	Average turbidity
Columbia River at Cascade Locks, Oregon	137	27
Klamath River at Klamath Falls, Oregon	146	...
Umatilla River at Umatilla, Oregon	247	79
Rogue River at Copper Canyon, Oregon (est.)	321	...
John Day River at McDonald, Oregon ..	324	245
Snake River at Weiser, Idaho	324	80
Owykee River at Owykee, Oregon	395	167
Rio Grande	14,840	...
Colorado River (flood conditions)	21,500	...

In my own experience I have seen rivers in Alaska which carry even larger quantities of such materials than the Oregon rivers, but in all these streams various types of fish are found regularly and in regions remote from the interference of population the fish fauna may be abundant. This, together with much other evidence, emphasizes the fact that at least so far as maintaining fish life is concerned, under natural conditions the quality of the material appears to be of first importance and the quantity of secondary character. That the same proviso applies also to man is evidenced by the serious epidemics of typhoid fever shown to have been due to the discharge at a single point of a relatively small volume of contaminated material, whereas the heavily silted waters of the Missouri, the Platte and other streams are not unsafe for drinking water because of the presence of the large quantities of earthy materials in solution or suspension.

A precise determination of the facts in the case of the Rogue River was sought first through a study of the river itself. This was carried out during two periods. In one the river was in its maximum low-water condition; the other period came after melting winter snows and early rains had swollen the stream, not to flood conditions but to the level of average maximum high water. In the first period placer mining activity had entirely ceased some time before, so that the river was clear of sediment; conditions within the stream could be well observed and those above low-water level, on the banks and in shallow areas accurately determined.

During the high-water conditions placer mining was being carried on at its maximum. The run-off from these operations was discharged into smaller tributaries or directly into the Rogue River itself. It was important to determine both the kinds of materials flushed into the stream in this manner and the quantity added to the river by all these undertakings. Early in the study it became apparent that the entire region was subject to periods of heavy rain and irregular as well as marked fluctuation in the water level of all streams. As a result the turbidity of the water and its load of materials in solution and suspension fluctuated naturally within wide limits. This was shown by government records covering a period of eleven months made at a point on the Rogue well above all placer mining. Natural erosion due to climatic factors tears down the hills and loads the streams in the same way and with the same materials that are contributed by the artificial erosion of placer mining.

When the study was extended to the materials involved, further observations disclosed that deposits from placer mining operations did not differ in chemical or physical character from those laid down by flood waters. Records were taken continually through the mining season at Grant's Pass above the influx of all placer mine run-off and at Agness below the addition of the last material from placer mining. These were tabulated and showed that while the maximum turbidity of the Rogue River water varied irregularly, the highest figures at one place were substantially the same as those at the other place. In other words, the maximum load carried by the river under present placer mine operations is not greater than that due at times to natural erosion.

The present extent of placer mining is clearly not equal to that undertaken by the first operations in 1850 to 1860 and at some periods thereafter. Then the work was prosecuted with great activity induced by the early discoveries and the highly profitable results of the original undertakings in this field. If present conditions are unfavorable for the fish there they must have been even more destructive at that time. The records available do not bear out this relation.

In the Rogue River itself the salmon run was maintained at a high level during the earlier periods of

marked activity in placer mining. The reduction in the run of the fish was most marked during the period between that earlier time of placer mining activity and the very recent years in which enhanced value of gold has led to a partial revival of the industry in that region.

A study of the materials in the run-off disclosed no substance inimical to the welfare of the fish, either young or old. In a recent bulletin[2] Dr. M. M. Ellis has given an analysis of the types of erosion materials and their effect on conditions of fish existence. He pointed out that in no way has erosion silt a known destructive influence but suggests that by forming a pollution blanket on the bottom and by increasing turbidity erosion silt and other suspensoids may have a critical limit. These two features were studied carefully in connection with the conditions in the Rogue River system.

Observations on the river under low-water conditions failed to reveal the presence of any continuous or impermeable layer of erosion materials which could serve as a blanket, cover fish foods or spawning grounds or in any way injure adults or young of these anadromous fish during the periods of their life history spent in the river. A further examination of the literature reveals no support for the popular opinion that sawdust, silt and other solid particles of the type found in the Rogue River can clog the gills and kill the fish by suffocation. Past experiments with such materials gave uniform evidence that natural substances are not the cause of mechanical injuries and do not clog the gills of the fish or kill the young.

To designate placer mine run-off as pollution is unjustified. While it may be called "waste" since it is discarded in the process, it contains only natural soil constituents and no foreign substances. None of the unstable materials or toxic substances which are common in domestic sewage or industrial wastes are found in the placer run-off in this valley. So long as the process remains as it now is the run-off can not pollute or contaminate the water of the river. The color comes from ferric compounds which are not harmful to the fish; it is persistent and contributes to the opacity of the water and thus to a degree offers protection against the wiles of the angler. At points where the water was too dense to see fish, it really contained very little sediment.

The very fine silt may be related to the primitive food supply of the young fish and have thus a favorable rather than an unfavorable influence. The Wisconsin survey has shown that colloidal organic material collects on minute solid particles to furnish culture media for aquatic bacteria. Very young fish from muddy waters, which I have often dissected under the microscope, have the gut well filled with mud. The organic materials ingested with the silt may be a valuable element in fish nutrition. This feature certainly deserves careful investigation.

In order to make the conclusions more convincing Dr. L. E. Griffin was secured to carry out in his laboratory at Reed College some experiments on young trout and salmon. The results of the experiments are reported in detail in Appendix B of my report just published. Young fish were held for three to four weeks in tanks through which was circulated water containing in constant suspension more than 1,000 parts per million of mud taken from placer mine areas in the Rogue River Valley. This is far more than the maximum amount (440 ppm) actually found in Rogue River water taken in at Agness. Yet the fish remained active and the percentage loss of life was less than expected among fish held in confinement. The condition of the fish was apparently slightly better than that of controls from the same source kept in tanks of clear water at the same place during the same period.

An important contribution to the report is Appendix A on "Rogue River Turbidity," by Arthur M. Swarbley, geologist in the Oregon State Department.

SCIENTIFIC EVENTS

THE NATIONAL GEOLOGICAL SURVEY OF CHINA

DR. GEORGE B. CRESSEY, chairman of the department of geology and geography of Syracuse University, has received letters from Peiping and Chungking concerning the present status of the National Geological Survey of China.

Some three years ago the headquarters of the survey were moved from Peiping to the new buildings in Nanking. With the evacuation of that city a year ago, the survey moved first to Changsha and more recently to Chungking. All the maps, rare books and type specimens in Nanking were packed for storage and are supposed to be safe. Some of the ordinary reference books, a large part of the survey's publications and the specimens under study were not shipped until the last moment and only a portion of them reached the interior in safety. Most of the apparatus thus sent away was damaged. The museum specimens were only partially packed and were either transported to the countryside outside of Nanking or left in the building. It is feared that all have been lost.

Dr. Wong Wen-hao is now at the survey headquarters in Chungking. One member is in Hongkong looking after printing arrangements, an additional

[2] U. S. Bureau of Fisheries, *Bull.* 22: 1937.