I have estimated the proportions of different foods in the total number of stomachs to be—Fishes, 60 per cent.; insects, 18 per cent.; crayfish, 7 per cent.; molluscs, 2·5 per cent.; plants, 12·5 per cent.

Galaxias.—The average length of 16 *Galaxias* sp. from the stomachs of Rotorua and Rotoiti trout was 56 mm. I believe most to be *Galaxias brevipinnis*, but identification cannot always readily be made on partly digested specimens. In all, 23 trout had eaten 132 *Galaxias*, an average of 5½ per trout.

Gobiomorphus.—The common bully, *Gobiomorphus gobioides*, was found to be the most common fish-food. In order to ascertain the number of this species in a given portion of Lake Taupo close to the beach, I enclosed an area of 30 square yards without disturbing the fish; and, after an hour's observation, was satisfied that there were over 160 examples of the species in the enclosure, together with a few *Galaxias* sp. In the lakes the bully prefers a rocky or pumice bottom and shallow water. I have taken several hundreds during a few minutes' dredging in Western Bay, Lake Taupo. The total length of the adult is generally 123 mm., but all sizes were found in trout-stomachs, the average size of 16 young being 42 mm. Altogether 32 trout had eaten a total of 216 of these fish, an average of 6½ per trout.

Salmo sp.—Two of the stomachs examined, one from Lake Rotoiti and one from Lake Tikitapu, contained the remains of a young trout.

Insects.—The insect contents of the stomachs examined were generally small, except in the case of stream or river fish. It was noticeable that out of 28 trout-stomachs examined from Lake Taupo only 5 contained insect food. At this season insect food is probably poorer in the lakes than during most months of the year. Dipterous larvae and cicadas were the most commonly found.

Paranephrops.—The crayfish, or koura (*Paranephrops planifrons*), was not largely represented in the trout-stomachs. During October, 1918, I found large numbers in the stomachs of trout from Lake Rotoiti. In the tabulated list 11 trout had taken 17 *Paranephrops*, an average of 1½ per trout.

Potamopyrgus.—The mollusc *Potamopyrgus* spp., of which there are several varieties, is found in all lakes, often being attached to the pond-weed, *Potamogeton Cheesemanii*. Seventeen trout had eaten 188 *Potamopyrgus*, an average of 11 per trout. Allowing for bones and cartilage, I have ascertained that a small *Galaxias* 50 mm. long equals in weight 36 molluscs without the shell.

Plants.—Out of the total 31 stomachs containing plants, 9 contained *Nitella*, 7 *Cladophora*, 4 *Ulothrix*, and 4 *Myriophyllum elatinoides*. Twenty stomachs were examined from the various lakes during September, October, and November, 1918 and 1919, and of these 15 contained an average of 40 per cent. plants. It will be seen that the proportion of plant food eaten was considerably less during February of this year.

Microscopical Organisms.—In 38 stomachs diatoms were found. Other organisms in varying numbers were *Rotifera*, *Paramoecium*, *Amoeba*, and flagellates such as *Pleurococcus* sp. in an encysted condition.

Histrichus.—The parasitic worm was found only in stomachs of trout from Tarawera and Taupo.

Stones, Gravel, and Pumice.—It seems likely that most sand or gravel in the stomach is taken accidentally with other food. In the case of pumice being taken it is possible that here also it had been accidentally swallowed owing to the buoyancy of the stone.

TABLE OF ANALYSES OF TROUT STOMACH-CONTENTS,* 10TH FEBRUARY TO 5TH MARCH, 1921.

Fishes.	Insects.	Crayfish.	Molluscs.	Plants.	Microscopical Organisms.	Remarks.
			LOCALITY—HAMURANA STREAM.			
..	Cicadas, 6	..	*Potamopyrgus*, 11	*Cladophora*, small quantity; blade of grass; seeds of plant	Diatoms, abundant ..	Intestine: numerous *Potamopyrgus*-remains. A yearling trout.
.	Hymenoptera, 7; *Eristalis tenax*, 1; *Lestes colensonis*, 2, Homoptera, 1	..	..	Young leaves and shoots of plant, probably *Ranunculus* sp.	Encysted flagellates, abundant; diatoms, abundant	Intestine: a few cicada-remains. Weight, $1\frac{3}{4}$ lb.
..	..	.	..	..	..	Stomach contained only wing and feathers of small bird; intestine empty. Yearling.
			LOCALITY—LAKE ROTORUA.			
Galaxias, 8 ..	Dipterous larvae, 2 ..	..	..	*Nitella*, 2 spp., small quantity with fruit	Diatoms, a few ..	Intestine: fish-remains, sand, and gravel. Weight, 4·8 lb.
..	..	*Paranephrops*, 2 (large)	*Potamopyrgus* 14	*Nostoc*, small quantity..	Diatoms, abundant; encysted flagellates, abundant; encysted amoeba, a few	Stomach and intestine: small stones, sand, and gravel.
..	Dipterous larvae, 8 ..	*Paranephrops*, 2	..	..	..	Intestine empty.
Galaxias, 1 ..	..	..	*Potamopyrgus*, 1	.	..	Intestine: sand and gravel. Weight, $3\frac{3}{4}$ lb.
Galaxias, 2 ..	..	..	..	*Oscillatoria*, small quantity	Encysted flagellates, a few; diatoms, a few	Intestine: fish-remains. Weight, $2\frac{1}{2}$ lb.
Galaxias, 14 ..	..	..	..	..	..	Stomach: sand and gravel. Intestine: fish-remains. Weight, 4 lb.
Galaxias, 6 ..	..	..	..	..	..	Intestine: fish-remains (a little). Weight, $2\frac{3}{4}$ lb.
Galaxias, 20 ..	..	.	*Potamopyrgus*, 3	..	Bacteria, bacillus, small numbers	Stomach and intestine: large quantity of sand and gravel. Weight, $3\frac{3}{8}$ lb.
..	..	..	.	..	..	Stomach empty. Intestine: fish-remains (*Salmo fario*).
Galaxias, 6 ..	.	..	.	.	Diatoms, a few ..	Intestine: digestive fluid.
Galaxias, 11 .	Dipterous larvae, 12 ..	..	.	..	..	Intestine: remains of about 12 *Galaxias*. Weight, $4\frac{1}{2}$ lb.
Galaxias, 7 ..	..	..	*Potamopyrgus*, 16	*Cladophora*, small quantity	..	Stomach and intestine: stones, gravel, and fish-remains.
Galaxias, 3 ..	Dipterous larvae, 5 ..	..	.	..	..	Intestine: fish-remains and fine sand.
Gobiomorphus, 1	Cicada, 1	..	*Potamopyrgus*, 11	..	..	Stomach and intestine: fish-remains, sand, and gravel.

* Except where otherwise indicated, all stomachs were taken from *Salmo irideus* or subspecies thereof.

TABLE OF ANALYSES OF TROUT STOMACH-CONTENTS,* ETC.—*continued.*

Fishes.	Insects.	Crayfish.	Molluscs	Plants.	Microscopical Organisms.	Remarks.
			LOCALITY—LAKE ROTORUA—*continued.*			
..	..	..	..	..	..	Stomach empty. Intestine: sand and gravel. Weight, 5½ lb.
Gobiomorphus, 1	Cicadas, 2	..	..	..	..	Intestine: gravel and pumice. Weight, 6 lb.
..	..	..	*Potamopyrgus*, 47	*Nitella*, a large quantity	Diatoms, abundant ..	Stomach and intestine sand and gravel. Weight, 3½ lb.
			LOCALITY—FAIRY SPRINGS STREAM.			
..	Caddis case, 1 ..	..	..	Small piece of moss ..	..	Intestine empty.
..	..	..	..	..	Encysted amoeba, a few; diatoms, a few	Stomach contained 16 pumice stones and piece of stick. Intestine: pumice and gravel.
..	..	..	..	*Nitella*, a trace ..	Diatoms, a few ..	Stomach: large pumice stone. Intestine empty.
..	..	*Paranephrops*, 1	..	*Nostoc* (?), a little ..	Encysted flagellates, a few	Intestine: crayfish-remains.
..	..	..	..	*Nitella*, small quantity..	Diatoms, abundant ..	Intestine empty.
			LOCALITY—LAKE ROTOITI.			
Galaxias, 6 ..	..	..	..	..	Diatoms, a few ..	Intestine: fish-remains, sand, and gravel.
Galaxias, 4; *Gobiomorphus*, 1	..	*Paranephrops*, 4	..	..	Rotifera, a few ..	Intestine: remains of crayfish. Weight, 7½ lb.
..	Dipterous larvae, 26; *Odontria* sp., 2	..	*Potamopyrgus*, 3		Diatoms, abundant ..	Stomach and intestine: sand and gravel.
Galaxias, 9 ..	..	.	*Potamopyrgus*, 1	..	Diatoms, a few ..	Intestine empty.
Galaxias, 4 ..	..	..	..	..	..	Intestine empty.
..	..	..	..	..	..	Stomach empty. Intestine: remains of 4 *Galaxias*. Weight, 5 lb.
Salmo sp. 1 (young)	Cicada, 1	..	*Potamopyrgus*, 5	..	..	Intestine: remains of numbers of small *Galaxias*.
Galaxias, 5 ..	Millipede (?), 1 .	*Paranephrops*, 1	..	..	..	Intestine: vertebrae of 6 *Galaxias*.
			LOCALITY—STREAM, LAKE OKAREKA.			
..	..	*Paranephrops*, 1	..	..	..	Intestine: straw, grass, piece of charred wood. Weight, 4 lb.
..	Cicadas, 5	..	..	..	..	Stomach and intestine: stones and gravel.

LOCALITY LAKE OKATAINA.

..	*Melampsalta cingulata*, 2	..	..	..	..	Intestine. small fish-remains Weight, 5¼ lb.
Galaxias, 1	*Melampsalta cingulata*, 6	..	..	..	Diatoms, a few ..	Intestine: remains of fish and cicadas.
Galaxias, 11	*Melampsalta cingulata*, 2	.	..	..	..	Intestine: remains of fish and cicadas.
..	.	..	..	..	..	Stomach empty. Intestine: fish-remains.
..	..	..	..	..	..	Stomach and intestine empty.

LOCALITY—LAKE TIKITAPU.

..	..	*Paranephrops*, 1 (large)	..	*Myriophyllum elatinoides*, a small quantity	Diatoms, abundant ..	Intestine: crayfish and fish remains.
Gobiomorphus, 1	..	..	..	..	..	Intestine: sand and gravel.
..	*Somatochlora*, 4; Hymenoptera (bee), 1; Diptera, 1	..	..	..	Diatoms, a few ..	Intestine: remains of Diptera. Age, 2 years.
..	Larva of *Oxyethira*, 25; imago of *Procordulia smithii*, 1; larva of *Procordulia smithii*, 1, Ichneumon fly, 1, *Melampsalta cingulata*, 4; *Pyronata festiva*, 1	*Paranephrops*, 1	..	*Cladophora*, a quantity..	Diatoms, abundant; encysted flagellates, common	Intestine: 2 feathers and remains of *M. cingulata*. Age, 2 years.
Salmo sp., 1 (young)	..	*Paranephrops*, 1 (large)	..	..	Diatoms, abundant; Rotifera, a few	Intestine: dead leaves, sand, and gravel.
..	Larva of *Sympetrum bipunctatum*, 9, caddis cases, 3	*Paranephrops*, 1 (large)	.	*Nitella*, a little; plant-seeds, common	Diatoms abundant ..	Intestine: caddis cases and crayfish-remains. Age, 2 years.

LOCALITY—LAKE ROTOKAKAHI.

Gobiomorphus, 28	..	..	*Potamopyrgus*, 5	*Nitella*, 2 spp., with fruit, a quantity	Diatoms, abundant ..	Intestine: large quantities of *Nitella* cells empty.

LOCALITY—PUAENGA STREAM (*Salvelinus fontinalis*).

	Diptera (*Tipula* sp.), 4..	..	..	*Nitella*, small quantity; *Nostoc*, small quantity; plant-seeds, numerous	Diatoms, numerous ..	Intestine: small quantity sand and gravel. Yearling trout.
..	Dipterous larvae, 4, *Cicindela tuberculata*, 1; weta, 1, traces of another beetle	..	..	..	Diatoms, numerous; encysted flagellates, common	Intestine: weta-remains, sand, and gravel. Yearling trout.
..	Grasshopper, 3 ..	..	..	*Nitella*, common ..	Diatoms, abundant ..	Intestine empty. Yearling trout.
..	Dipterous larvae, 5; Diptera (*Tipula* sp.), 3, grasshopper, 1	..	..	Plant-seeds, common ..	*Paramoecium*, a few; diatoms, common; encysted flagellates, a few	Stomach: also piece of stick, sand, and gravel. Intestine: sand and gravel. Yearling trout.
..	Dipterous larvae, 3 ..	..	..	*Nitella*, common ..	Diatoms, numerous; encysted flagellates, numerous	Intestine. grasshopper-remains. Yearling trout.

* Except where otherwise indicated, all stomachs were taken from *Salmo irideus* or subspecies thereof.

TABLE OF ANALYSES OF TROUT STOMACH-CONTENTS,* ETC.—*continued.*

Fishes.	Insects.	Crayfish.	Molluscs.	Plants	Microscopical Organisms.	Remarks.
			LOCALITY—LAKE TARAWERA.			
Gobiomorphus, 3	..	..	..	..	..	Intestine: fish-remains; a little sand and gravel.
Gobiomorphus, 2	*Odontria* sp., 1 ..	..	*Potamopyrgus*, 5	..	..	Stomach and intestine: sand and gravel.
Gobiomorphus, 4	..	..	*Potamopyrgus*, 5	Grass-like plant, small quantity	Diatoms, a few ..	Stomach also contained Nematode parasitic worm, *Histrichus* sp. Intestine empty.
Gobiomorphus, 26	..	..	..	..	..	Intestine: *Gobiomorphus*-remains. Weight, 4½ lb.
Gobiomorphus, 12	Cicada, 1	..	..	..	..	Intestine empty.
..	..	..	..	..	..	Stomach: only *Histrichus* sp. Intestine empty.
..	..	*Paranephrops*, 2	*Potamopyrgus*, 34	..	..	Intestine: numerous *Potamopyrgus* shells and fish-remains.
..	..	..	..	..	..	Stomach: 4 *Histrichus* sp.
			LOCALITY—WAIKATO RIVER (ABOVE HUKA FALLS).			
..	*Hydropsyche* larvae, 114	..	*Potamopyrgus*, 16	*Cladophora*, large quantity; *Mougeotia*, small quantity	Diatoms, abundant; encysted flagellates, numerous	Stomach and intestine: sand and gravel. Weight, 8 lb.
			LOCALITY—LAKE TAUPO.			
Galaxias, 2 ..	..	..	..	..	..	Stomach: 4 *Histrichus* sp. Intestine empty.
Galaxias, 3 ..	Spider, 1	..	..	..	..	Stomach and intestine: numerous eggs of spider.
Galaxias, 2 ..	..	..	..	..	..	Intestine: fish-remains.
Galaxias, 4 ..	..	..	..	*Myriophyllum elatinoides*, small quantity	Diatoms, a few ..	Stomach and intestine: small quantity of sand and gravel.
Galaxias, 2 ..	..	..	..	..	..	Stomach: 2 *Histrichus* sp. Intestine: sand.
Galaxias, 1; *Gobiomorphus*, 4	..	..	*Potamopyrgus*, 6	*Potamogeton Cheesemanii*, small quantity	Diatoms, abundant ..	Stomach and intestine: small quantity of sand and gravel. Intestine: fish-remains.
Gobiomorphus, 10	Several dipterous insect remains	..	..	..	..	Stomach: 6 *Histrichus* sp.
Gobiomorphus, 1 (large)	..	..	..	*Ulothrix*, large quantity	Diatoms, abundant ..	Intestine: large quantities of filamentous algae.
Gobiomorphus, 13	..	..	..	..	..	Intestine: remains of *Gobiomorphus*.

Gobiomorphus, 4 (large)	Dipterous insect, 1 ..	..	..	..	..	Intestine: remains of dipterous insects.
Part remains of small fish	..	..	..	*Myriophyllum elatinoides*, large quantity; *Cladophora*, a quantity; moss, small quantity	Diatoms, abundant ..	Intestine: fish-remains.
Gobiomorphus, 8	..	..	..	..	..	Stomach: also 4 *Histrichus* sp. Intestine empty.
Gobiomorphus, 1	..	..	..	..	..	Stomach: also 1 *Histrichus* sp.
Gobiomorphus, 1 (large)	..	..	..	*Myriophyllum elatinoides*, a quantity; *Ulothrix*, small quantity; *Cladophora*, small quantity	Diatoms, abundant ..	Intestine: *Ulothrix* and fish-remains.
Gobiomorphus, 1	Ichneumon fly, 1 ..	..	..	..	Diatoms, numerous; Rotifera, a few	Stomach and intestine: dead leaves, sand, and gravel.
Gobiomorphus, 5	..	..	..	..	..	Intestine: fish-remains.
Gobiomorphus, 18	..	..	..	..	Diatoms, common ..	Stomach and intestine: a little fine sand.
Gobiomorphus, 7	..	..	..	..	..	Intestine: fish-remains, sand, and gravel.
Gobiomorphus, 10	..	..	..	*Oscillatoria*, a quantity..	Diatoms, abundant ..	Intestine: fish-remains, and a little sand and gravel.
Gobiomorphus, 7	..	..	..	..	..	Intestine: fish-remains. Weight, 7 lb.
Gobiomorphus, 4	..	.	..	..	Diatoms, abundant ..	Intestine: not examined. Weight, 5 lb.
Gobiomorphus, 19	..	..	..	*Oscillatoria*, a little; piece of grass-like weed	Diatoms, abundant ..	Intestine: fish-remains, filamentous algae, and sand.
Gobiomorphus, 3 (large)	..	..	..	..	Diatoms, a few ..	Stomach and intestine: pieces of stick, fish-remains, and a little sand.
Gobiomorphus, 2	..	..	..	*Ulothrix*, small quantity, *Nostoc*, a little	Diatoms, abundant ..	Intestine: fish-remains.
Gobiomorphus, 6	..	.	..	..	..	Intestine: fish-remains, a trace.
Gobiomorphus, 3	*Eristalis tenax*, 1; dipterous larvae, 5	..	..	..	..	Intestine empty.
Gobiomorphus, 5	..	..	..	*Ulothrix*, small quantity	Diatoms, abundant ..	Intestine: fish-remains.
Gobiomorphus, 5	..	..	..	*Cladophora*, large quantity; portions of dicotyledonous leaves; fragments of moss	Diatoms, abundant ..	Intestine: a fragment of moss.

* Except where otherwise indicated, all stomachs were taken from *Salmo irideus* or subspecies thereof.

Trout Food-supply.

Stomachs of the koura (*Paranephrops planifrons*), the tadpole of the Australian frog (*Hyla aurea*), the toitoi (*Gibiomorphus gobioides*), the gudgeon (*Galaxias brevipinnis*), and the koaro (*Galaxias huttoni*) were examined microscopically, and each found to contain enormous numbers of Diatoms, Algae, and Protozoa. Insect-remains were rarely found.

In the years 1918 and 1919 I had the opportunity of examining the stomachs of a number of trout taken in the streams after the close of the spawning season. The stomachs of many were found to be quite empty; some contained stones, and some the eggs of others which had just spawned. Practically all the larger and healthier fish return to the bed of the lake immediately after spawning. Accordingly, stomach-contents of trout taken in streams in the latter part of September and during October and November cannot be regarded as typical. These fish are for the most part females which, owing to weakness or disease, have been unable to deposit their ova at an earlier date. An attempt was made to fertilize ova of such fish artificially, the result being that over 90 per cent. proved sterile.

The tabulated results of analysis of stomach-contents cannot be regarded as forming a true estimate of the general food of thermal trout throughout the year, but will give some idea of the relation and proportion of foods eaten during February. For comparative purposes I submit the results of analysis of trout food-supply by various authors.

Kendall and Goldsborough (1908, p. 47) have found the rainbow trout in the Connecticut lakes to subsist largely on worms and insect-larvae. Note is also made of the great harm done through this predatory species eating the eggs of salmon.

Pearse (1918, p. 274) gives the food-example of *S. irideus* as follows: Insects and insect larvae and pupae, 43 per cent.; amphipods, 42 per cent.; millipeds, 10 per cent.; snails, 5 per cent. Eighteen specimens of *Salvelinus fontinalis* were examined, the average results being—Insects and insect larvae and pupae, 57·9 per cent.; millipeds, 0·4 per cent.; mites, 0·4 per cent.; amphipods, 35·5 per cent.; aquatic isopods, 0·5 per cent.; terrestrial isopods, 0·8 per cent.; snails, 1·4 per cent.; plant-seeds, 0·1 per cent.

Hudson (1904, p. 93) has given an excellent series of notes determining the species of insects and insect-larvae forming the staple food-supply of trout in New Zealand rivers. His results show the large extent to which insect food is utilized, but these results cannot be fully recognized as comparable with the existing conditions in the environment of trout in the land-locked lakes of the thermal district. The trout were examined by Hudson during the years 1899–1902, and all were from coastal rivers and streams. The average trout of the Rotorua and Taupo districts is a lake fish associated with shoals of smaller indigenous fishes which persist in much larger numbers than in any New Zealand river which I have examined.

Needham (1902, p. 205) has given a table of the stomach-contents of 25 brook-trout in New York State. The results show an almost complete absence of food other than insects. On p. 206 he states: "I am inclined to regard only the three first named in the table (*Chironomus, Corethra,* and *Trichopter* larvae and pupae) as of any considerable importance to the trout. To my mind the chief value of this table is that it clearly indicates one species of economic importance to trout-culture—the Chironomid, of whose larvae and pupae an average of 116 specimens had been eaten by the trout. The largest number eaten by a single trout was 351, while three trout had eaten none at all." Needham carried out an interesting experiment by feeding a dragon-fly nymph, *Libellula pulchella,* on *Corethra.* On p. 210 he states: "Placed in the nymph's mouth they were eaten with avidity; but placed thickly in the water with it, and swimming around within easy reach, none were captured, or even reached after, by the nymph. It was probably unable to see them, for it quickly seized water-boatman (*Corisa*) when substituted for the *Corethra* larvae." If aquatic insects are to be introduced into New Zealand as trout-food, it would be well first to have as exact a knowledge as possible of how far the aquatic forms will prey on indigenous species, and also whether the adults acclimatize successfully when mature.

In regard to the suitability of insect food as opposed to fish food for trout, Atkins (1910, pp. 841–51) has shown the potency of the larvae of flies in promoting growth. Experiments carried out by him showed that the fry of salmon fed with insect-larvae exceeded in growth by 27 per cent. those fed on chopped meat. Whether adult trout fed on insect-larvae would thrive to a greater extent than those fed on small fishes remains yet to be proved. The enormous number of insect-larvae which would be required to equal, say, six small fishes 4 in. long may easily make the task of increasing the supply of insects over the large areas of New Zealand lakes much more difficult than the increase in the numbers of small fishes and other forms suitable as food. The small fishes (*Galaxias* spp.) have invariably a large amount of fatty tissue, and in every stomach in which I found one or more of these fish oil-globules were numerous.

Embody (1918, pp. 26–33) has given a record of a number of experiments performed at the experimental hatching-station, Cornell University, the aim being to ascertain a substitute for the fresh-meat food used to feed trout for commercial purposes. An interesting note in regard to the mortality during experimentation is as follows: "In general fingerlings were more susceptible than yearlings and older trout, and rainbow trout were less resistant than brook and brown trout. In nearly all cases this high mortality could be checked in the course of two weeks by changing to a diet of some fresh meat."

Kendall (1918, p. 534) states that the general food-supply upon which the adult fish depends may be divided into two classes—fishes and insects. Further, he adds that in all waters there is a seasonal supply of insect-larvae which varies with the season and locality; but where food in the form of fishes is available the insect food appears to be more or less neglected, particularly by the larger fish.

This statement is interesting when Salmonidae are considered in the light of evolution. It is now recognized that the family as it exists to-day is derived from an ancestral form which existed about the Cretaceous period, and whose natural habitat was the ocean. It will be seen that many of the same types of food may have been utilized by the ancestral form, with the exception of insects. Accordingly insects and insect-larvae have gradually entered into the category of food-supply as Salmonidae have taken to rivers and streams.

Deterioration.

Regarding the growth of trout in the mountain-lakes of eastern Norway in comparison with the degenerate condition of trout on the western side, Dahl (1919, p. 28) notes as follows :—

—	West.	East.
Food ..	Mostly insects and small organisms	Mostly large animals, fresh-water shrimps, snails, and *Lepidurus*.
Lakes ..	Often deep, and therefore little productive	Often shallow, and therefore more productive.
Spawners..	Small and young, therefore vigorous reproduction	Larger and older, therefore slower reproduction.
Ova ..	Small, with small growth-capacity	Large, with better growth-capacity.

Dahl's researches are of great interest and importance ; but much further investigation seems to be required before these reasons and results may be accepted in their entirety.

Armistead (1920, p. 58) states as follows : " A stock of mountain-trout subjected to a favourable environment may grow and improve for some years. After a time a recoil takes place and the improvement is replaced by a deterioration, apart, as far as I can tell, from the question of food. It is as though the vitality accumulated originally through generations of hardship was exhausted in the process of growth."

Dahl (1919, p. 33) states that " growth depends on the qualities of the mother fish and the size of the ovum (*i.e.*, the size of the yolk-sac of the ovum)." Thus it would seem that, apart from the amount of food-supply available at the stage when feeding commences, the whole future history of the trout depends (1) on the amount of nutriment available for the embryo in the yolk-sac, (2) on what may be termed the inherent constitutional vigour imparted by the parents to their progeny.

There can be no doubt that decreasing food-supply has a direct bearing on the question in the thermal lakes, but I am of the opinion that this is not the solution of the whole problem.

In regard to Dahl's tabulated observations, it would be interesting to ascertain whether outside fry or young trout were introduced into any of the lakes to augment the parent stock ; also whether the trout of the eastern lakes of Norway had greater natural facilities for sexual intermixing than was afforded the trout on the western side. Further, it may be that certain inorganic constituents of the separate waters have been responsible for the predominance of two different types of plankton and benthos.* In the thermal-lakes district I have examined the yolk-sac of the ovum of fishes of different sizes and ages, and have found that in large trout, six to eight years, the yolk-sac is relatively larger than in younger and older trout. The rainbow trout of these lakes reach their maximum weight and condition at about six years. In my opinion it is these large trout (which at the age of six years weigh anything up to 9 lb.) that more than others will be likely to produce a strong and healthy progeny, and thus aid in maintaining the basic standard of the race.

Progeny derived from the same parents may not impress upon their progeny a strong constitutional vigour. Milne (1917, p. 37) writes : " It has been noticed that if eggs are collected annually to the full capacity of a minor tributary in a large watershed, and some of the progeny are

* Phillipps and Grigg (1922) have given considerable data on the relations of organic and inorganic geochemistry to fish life.

planted in the parent stream, the run falls off and may eventually disappear." These remarks refer to the salmon on the Pacific coast of North America. In the state of nature many of the eggs of the adult fish do not arrive at maturity, and the mortality among young fish is generally high; but in the artificial condition of the hatchery the loss is small. The fact that among the progeny liberated as described by Milne as many as several thousand may have been derived from the same parents significantly points to an inbred condition as being the most probable explanation of the run falling off.

At the present time (1923) the phenomenal increase in weight and size of thermal-lake trout is everywhere recognized. It is quite possible from facts to hand in regard to present condition of trout, which in certain lakes average 9 lb. in weight, that these fish have recovered from what may be regarded as a degeneration-cycle. Land-locked Salmonidae throughout the world have been known to deteriorate at intervals of several years. Many regard decreasing food-supply as the key to this problem; but this is certainly not the case in the thermal region, where the relative abundance of plankton has not altered since 1918, while the weights of fish have gradually increased since 1919.

Of all aquatic animals able to exist in temperate zones, Salmonidae are perhaps the most susceptible to change of environment, and respond almost immediately to altered conditions of any kind. Apart from human agencies, the geology of the surrounding country, its flora and fauna, altitude, latitude, and climatic conditions must all be considered when dealing with salmon or trout from a scientific standpoint.

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Second Supplement to the Uredinales of New Zealand.

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Since Parts 1 and 2 of "The Uredinales, or Rust-fungi, of New Zealand" were published (*Trans. N.Z. Inst.*, vol. 54, pp. 619–704; *ibid.*, vol. 55, pp. 1–58, 1924) the following additional species and hosts have come to hand:—

1. Uromyces Edwardsiae n. sp.* (Fig. 128.) Leguminosae.

0. Spermogones unknown.

III. Teleutosori on pods which have become converted into distorted, rugulose, inflated, piriform galls, attaining a size of 40 × 18 mm.†; chocolate, pulverulent, covering the entire surface, naked. Teleutospores broadly elliptical, less commonly obovate, 30–40 × 22–26 mmm.; apex rounded or bluntly acuminate, slightly (3–4 mmm.) thickened, base attenuate or rounded; epispore 2–3 mmm. thick, conspicuously longitudinally reticulate, with, in addition, a few coarse warts near the apex, pallid chestnut-brown; pedicel deciduous, hyaline, up to 15 × 6 mmm.; germ-pore apical, conspicuous, frequently crowned with a tinted papilla.

Host: *Edwardsia tetraptera* (J. Miller) Oliver (= *Sophora tetraptera* J. Miller). On pods. Herb. No. 1234. III. Tahakopa, Catlins (Southland), 70 m., *C. M. Smith!* March, 1923. (Type.)

The host is indigenous and widespread; it occurs also in Lord Howe Island, Easter Island, Juan Fernandez, and Chile (Cheeseman, 1906, p. 123).

The fungus attacks the pods shortly after flowering, causing them to become distorted and much inflated. In place of the normal pod, 5–20 cm. long, a short piriform gall is formed in its stead. The surface of the gall is much wrinkled and covered with the masses of chocolate-coloured sori. The epispore of the teleutospore is covered with distinct reticulations, arranged in parallel rows which converge at the poles This character separates this from every other species occurring on the genera *Edwardsia* and *Sophora.*

No less than six species of *Uromyces*, and two of the form-genus *Aecidium*, have been recorded as occurring on these two genera, as under:—

II, III. *Uromyces hyalinus* Peck. America. Leaves and stems.
II, III. *U. shikokianus* Kus. Japan. Leaves.
III. *U. cladrastidis* Kus. Japan. Leaves.
III. *U. truncicola* P. Henn. et Shirai. Japan. Stems
II, III. *U. Sophorae-japonicae* Diet. Japan. Leaves.
II, III. *U. Sophorae-flavescentis* Kus. Japan. Leaves.
I. *Aecidium Sophorae* Kus. Japan. Leaves.
I. *A. kowhai* G. H. Cunn. New Zealand. Stems.

The majority of these species of *Uromyces* possess verruculose teleutospores, but none have the peculiar reticulations so noticeable in our species; the gall-forming habit, and habitat on pods, are also characteristic features.

Particulars as to the Japanese species have been obtained from a recent paper by Ito (1922).

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* Latin diagnoses are placed at the end of the paper.

† In this article the contraction "mmm." is used for micromillimetres.