Table of Lengths of Fins in Inches of Otago Trout, 1883.

Locality.	Sex.	Wght. in lbs. & ozs.	D.	P.	V.	A.	Total Lngth.	Least depth of tail.	Remarks.
Kakanui River ..	F	8	3·3	3·5	2 6	2·4	24·5	2·2	Caught by Mr. S. Lowe.
Shag River ..	F	4·12	3·0	3·0	2·6	..	23·0	2·0	„ at Rich's.
„ ..	M	4·8	2·8	3·0	2·2	1·8	20·7	1·8	„ at Muir's.
„ ..	F	5	3·0	3·0	2·5	2·0	22·0	..	„ at Rich's.
„ ..	F	2·4	2·2	2·6	2·1	1·7	18 0	1·5	„ at Kitchener's.
„ ..	F	2	2·0	2·3	1·8	1·4	16·5	1·5	„ „
Waikouaiti River	F	14	3·75	4·5	3·4	2·7	28·5	2·5	„ by Mr. H Orbell.
Water of Leith ..	F	17	3·75	4·0	3·25	4·0	33·0		
„ ..	F	5	2·5	2·8	2·2	2·0	21 25	1·7	Harbour, mouth of Leith.
Lee Stream ..	F	1·9	2·0	2·3	1·9	2·2	15·5	..	Gorge water.
„ ..	F	3·10	2·8	2·8	2 3	2·5	20·5	..	„
„ ..	M	2·12	2·4	3·0	2·2	1·6	18·5	1·6	„
Tokomairiro River	F	7·4	3·6	3·5	2·8	2·7	26·5	2·2	Caught by Mr. J. Burt.
Waiwera River ..	F	2·13	2·2	2·2	2·2	2·6	18·0	1·6	
Teviot River ..	F	0·14	1·7	2·1	1·6	1·3	14·0	1·3	
Boat Harbour Creek	F	3·4	2·5	2·9	2·0	2·0	20·5	1·75	Found dead.
Pomahaka River	F	2·6	2 3	2·5	2·0	1·6	18·0	1·6	
„ ..	F	3·2	2·4	3·0	2·3	2·0	19·5	1·75	
Waipahi River ..	M	4·2	2·8	3·0	2·5	2·0	21·25	1·75	
„ ..	M	5·8	3·0	3·7	3·0	2·2	24·0	2·0	
„ ..	M	8·10	3·5	3·75	3·0	2·3	24·75	2·2	Caught by Mr. Bull.
„ ..	F	6·1	3·25	3·5	2·75	2·25	24·5	2·25	
„ ..	M	4·8	3·0	3·4	2·7	2·0	21 05	2 0	
Kaihiku River ..	F	5·5	3·25	3·25	2·7	2·25	24·25	2·0	
Oreti River ..	F	5·0	2·75	3·0	2·2	2·0	20 75	1·9	
Wakatipu Lake ..	M	8·4	3·2	3·8	2·7	2·4	25·5	2·3	
„ ..	M	9·4	3·8	4·0	3·0	2·8	26·0	2·6	
„ ..	M	12·0	3·75	4·0	3·1	2·5	26·5	2·5	Sent by Mr. Dalgleish.
(Canterbury fish)	F	2·0	2·0	2·1	1·6	1·8	15·5	1·6	„ Mr. S. C. Farr.

Note.—The proportion or ratio which the length of any fin bears to total length of the fish as expressed by L—D, L÷P, etc., has been used by me for ascertaining the differences in the length of the fins between individual fish and between the sexes, and may be readily deduced from above table.

Art. LVI.—Sorghum *Experiment*, 1882–83. By Mr. Justice Gillies.

[*Read before the Auckland Institute, 20th August*, 1883.]

Having no land of my own fit for growing *Sorghum* this year, Mr. W. F. Buckland kindly undertook to grow half an acre for me on his property at Remuera. The land is a strong volcanic loam, had been under crop for several years, and had a good deal of sorrel in it. Mr. Buckland manured the land with one and a half cwt. of bone dust. On the 20th of October, 1882, he planted exactly half an acre with "Early Amber" *Sorghum* seed supplied by me. The seed was planted in rows 3 feet apart, and about three seeds

* See Trans. N.Z. Inst., vol. xiv., p. 373, and vol. xv., p. 261.

2 feet 6 inches apart in the rows. The land was kept free from weeds by one hand-hoeing and two scarifyings during the season. In a few days the plants showed above ground, but, as usual, were very weakly at first, and did not make much growth for about six weeks, when they shot up with extraordinary vigour. There were a few misses in the rows, in which fresh seed was planted, but it never caught up to the first sown, and got smothered out when the rapid growth set in. The crop, when fit to cut, was about 11 feet high, and contained, by estimation (founded on one ton cut and weighed), at least eight tons of cane. By the 7th March the cane, or at least a considerable portion of it, seemed ripe enough for cutting. I, therefore, had about half a ton cut, topped, stripped, and carted to my mill on that date. On the morning of the 8th we commenced crushing (the cutting being continued) till we had one ton weighed of cane, which was crushed in about seven hours, yielding about 84 to 90 gallons of juice. The juice showed a slightly acid reaction on litmus. I heated it in a copper boiler to 160° F., and added cream of lime till the acid was neutralized, without showing any alkaline reaction, and then brought it to boiling point. After a few minutes boiling, allowed it to settle, and, when sufficiently settled, we drew off between 60–65 gallons of fine clear amber coloured juice into the evaporator. (We had not time to strain the remainder of about 20 gallons.) I used no sulphurous acid on this occasion, there appearing to be no excess of lime. We then evaporated the juice carefully in the open evaporator. Fearing to burn the syrup, we drew it off before it showed sufficient signs of crystallization. The nett result was about 10 gallons of beautiful golden syrup. This we poured into shallow wooden vessels to cool, but after leaving it in these for several days, and finding but little signs of crystallization, I put it into glazed earthenware jars, taking some samples in glass jars for further experiments. After a few weeks I found a considerable amount of sugar crystallized in the jars. One of the samples taken I further evaporated, which, when cooled, crystallized, giving, when drained under pressure, 8 ozs. sugar of fine grain of a pale straw colour, leaving 6 ozs. of rich treacle. Mr. Buckland also experimented with a similar sample. He informed me that he carefully boiled the syrup for about half an hour, when he found it give the proper test for crystallization. He then poured the syrup back into the bottle, and in a few days it had crystallized. He had some difficulty in separating the sugar from the treacle, but eventually succeeded in producing the sugar, fully 6 ozs., now exhibited in bottle No. 1. Bottle No. 2 contains the treacle left. The greater weight produced from my sample arises probably from it not having been so well dried as Mr. Buckland's.

Mr. Buckland further experimented with a jar of the syrup containing about one gallon. After it had stood for some months, he boiled the syrup as before until it stood the proper test. He then poured it into soup-plates. A week having elapsed without any sign of crystallization, he poured it from the plates into five glass salt jars. In a few days he found it had all crystallized, but when he went to treat it further, he found that the contents of two of the jars had reverted to syrup. He then treated the three that were in order so as to extract the sugar.

On pouring out the contents of one of the jars, which had reverted to syrup, it at once crystallized, and he extracted the sugar. The remaining jar has since crystallized, but has not been further treated. He thinks that these two obstinate jars got more of the thin top of the syrup than the others in pouring it from the soup-plates. He obtained from this second experiment about 1½ lbs. of the sugar you see in those two glass jars, Nos. 2 and 3.

Of course these somewhat roughly-made experiments give no data for estimating the proportion of sugar which can be extracted from the syrup. In dealing with these small quantities there is a constant loss, as every time the material is poured from one vessel to another, a considerable portion sticks to the vessel. What is proved, is, that in the syrup there is a large amount of good sugar crystallizable and extractable even by the roughest processes. If vacuum pans were used for concentrating with certainty the syrup to crystallizing point without risk of burning, and centrifugal machines used for extracting the sugar, as is now successfully practised in America, then, alone, could the exact proportion of sugar to syrup be determined. A much better quality of sugar is also thus prepared, fetching 8 cents. per lb. in the market in America, whilst that prepared in open pans fetches only 4½–5 cents.

The following results I claim to have established:—1st. That the Early Amber *Sorghum* is well suited for our soil and climate, from the Bay of Plenty northwards. 2nd. That on average soils, from 12–16 tons per acre of cane may be grown at an expenditure not greater than for a crop of maize. 3rd. That 40–50 per cent. of weight of cane, equal to 90 gallons per ton, may be expressed as juice. 4th. That the juice properly treated will produce one-sixth of its bulk, or 15 gallons of a rich syrup, far superior to ordinary molasses, which will keep unaltered by fermentation for many months.

What I expect to see in the future is this: that our northern farmers will grow *Sorghum*, crush, and concentrate the juice to syrup, not attempting to make sugar themselves, but sending their syrup to the sugar-refining works now in course of erection near Auckland, where it will be properly treated, and the sugar produced by the most approved processes. As the

concentrated syrup weighs 14½ lbs. to the gallon, it would, if sold at the absurdly low price of 1d. per lb. (in America it sells for 7 cents. per lb.—or 3½d.), produce a gross return of £14 10s. per acre, a sum sufficient to yield a fair profit per acre; as I calculate that with a two-horse mill crushing 80 gallons of juice, or 1 ton of cane per hour, the total expense of crushing and evaporating should not cost, (within reasonable distance of coal,) over 10s. per ton, or £6 per acre. This is, of course, only calculation, as the actual cost in my experiments, employing special labour, came to about £1 per ton, or £16 per acre. But even this would leave a good profit with syrup at 2d. per lb. On a farm no labour would be required other than the ordinary labour of the farm, and the leaves and seed would be an important and valuable item in the feeding of stock and poultry.

I have now finished my experiments, as my increasing public duties will prevent my further prosecuting them. It remains for some intelligent farmer to take up the matter, and test the results I have obtained. To such an one I shall be happy to hand over my crushing-mill, boiler, and other apparatus, as well as afford him every advice and assistance in my power. I feel thoroughly convinced that, at no distant date, the growth of *Sorghum* will be found to be one of the most paying crops that the northern farmer can produce.

Supplementary Paper on Sorghum. By Mr. JUSTICE GILLIES.

[*Read before the Auckland Institute, 17th September*, 1883.]

SINCE reading my paper on *Sorghum* at last meeting I have received from Dr. Hector the results of the Colonial Laboratory analysis of a one gallon jar of syrup sent him some four months after it was made. These results and the data they afford as to the commercial value of growing *Sorghum* for sugar production are of the utmost value. The following is the report:—

Syrup for proportion of cane and grape sugar—	lbs.	oz.
Weight of syrup separated from crystallized sugar	12	3
Weight of crystallized sugar therein	0	12½
Total	12	15½

At a temperature of 60°, specific gravity 1·406 water at 1·000, the syrup contained 71·60 per cent. of cane sugar. The syrup and sugar gave 7·15 per cent. of grape sugar.

	lbs.	oz.
71·6 per cent. upon 12lbs. 3oz. of syrup gives of sugar	8	11½
Sugar crystallized spontaneously	0	12½
Total cane sugar	9	8