73/7

FISHING INDUSTRY RESEARCH TRUST ACCOUNT
REPORT ON PROJECT 1974/75

(1) Title of Proposal: Fish Smoking Extension Service.

(2) Name of Applicant: New South Wales State Fisheries and the New South Wales Fishermens Co-operative Union.

(3) Division, Department or Section: Scientific Section.

(4) Proposal: The objective was to establish a scientifically orientated viable fish smoking industry.

(5) Name of persons responsible for programme: Dr D.D. Francois

(6) Qualifications of staff employed on programme: Technical Officer (Grade 11) Patrick C. Parrish

(7) Location of Operations: Three operational bases are in use.

(a) A co-ordinating and major experimental centre in Sydney at the Gore Cove terminal of the F.R.V. "Kapala".

(b) Eden Fishermen's Co-operative, Eden

(c) Clarence River Fishermen's Co-operative, Maclean

(8) Date project commenced: The project commenced formally at the beginning of the financial year 1973/4 with the appointment of the Technical Officer.

(9) Completion Date: July 1975

(10) Report on Project:

Some information relating to the programme is contained in the current application to the FishingIndustry Research Trust Account Committee for funds for a project "Fish Product Development", and a complete report is now being prepared by New South Wales State Fisheries. A summary of the various sections is presented here.

OBJECTIVES

The project was planned to develop an economically viable smoked fish industry. The programme was as follows.

(a) The establishment of fish smoking in the two Co-operatives by provision of two forced draught mechanical smoke kilns of modern Torry design.

(b) Provision of a fish smoking extension service.

(c) Investigation of those species whose qualities and availability indicate suitability for a large scale curing industry.

(d) Application of smoke-curing techniques using a 'Torry' design kiln to those species of fish which were found most suitable.

(e) Investigation and definition of variations which may arise in the quality of the product due to seasonal or other factors.

(f) Study of the keeping qualities of the fish, both fresh and smoked, with a view to assessing the practicability of using species available seasonally in glut quantities.

RESULTS

(a) Installation of kilns

Because of shipping delays the Torry kilns were not installed until the early part of 1974. However, previous work carried out at Core Cove ensured a fairly uncomplicated inauguration. The success of the kilns was soon demonstrated by the application of the Maclean Fishermens Co-operative to the Commonwealth Department of Agriculture for funds to purchase a much larger Torry kiln. The Eden Co-operative was slower to achieve success, but by mid 1975 was marketing smoked hake as far afield as Canberra and was looking to expansion with a larger kiln.

(b) Extension Service

The experience gained from installing and operating these kilns, and the previous publications on smoke house construction and brining of fish enabled the State Fisheries to deal with a wide range of enquiries from individuals and companies interested in fish smoke curing.

(c) Choice of Suitable Species

Species of fish for investigation were selected by reference to the statistical publications of the Fish Marketing Authority. It was decided that nannygai, morwong, hake and mullet were potentially suitable because of their relative abundance and low average price. But after further investigation only hake and mullet proved to have a suitable fat and protein content and the programme was limited to these two species.

(d) Effects of Smoking

A study was made of the smoke density, relative humidity and heat in smoke curing. These factors are related to the weight loss and general acceptability of the finished product.

It was found that smoke deposited more readily in the first hour of smoking while the fish is still moist, and that the density of the smoke decreases as the temperature rises.

The variety of sawdust used had little significance for the taste panel, provided it was not resinous.

It was also found that there was an inverse relationship between the size of the fish and the moisture loss during a three hour hot smoke.

Additionally it was established that fish frozen and then smoked had more flavour than if the fish were smoked and frozen. This was considered to be the result of loss of salt and smoke flavour with the onset of "thaw drip". (Details of this work will be published in the near future)

(e) Quality Variations

Mullet in particular is subject to wide seasonal variation in muscle structure. Before gonad development a heavy layer of fat builds up around the rib cage which disappears at the end of the spawning. This raises problems both of taste and keeping quality. The excess fat proves objectionable to some palates, and because of rapid oxidation becomes rancid if not kept under low temperature refrigeration.

Hake did not appear to have such limiting factors and, if processed while very fresh, proved to have outstanding keeping qualities.

(f) Keeping Qualities

In general terms it was found that fish, filleted and packed in waxed cartons would keep as long as twelve months at -30°C without noticeable ill effect on the finished smoked product.

CONCLUSIONS

Techniques for smoking fish economically and producing a palatable product were established.

The two kilns at Eden and Maclean are in production on a commercially sound basis and are planning for expansion.

A number of other centres have also commenced operations including two at Ballina - one private enterprise and one at the Fishermans Co-operative - one at Tea Gardens and one at Mannering Park. (These last four are using kilns designed by the department).

The programme has very largely achieved its objectives in demonstrating the viability of a modern smoked fish industry using suitable fish. Further developments could assist to some extent in reducing the fluctuation in fish prices by providing an alternative outlet for what otherwise would be surplus, bearing in mind that the present market valued at $4 million is catered for almost totally by imports.

EXPENDITURE: 1st July 1975 to 31st December 1975

Salaries and wages	$5,383.54
Operating expenses	1,045.38
Capital costs	1,179.53

All expenditure has been met by N.S.W. State Fisheries.

REFERENCES

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Parrish, P. Brines and Brining. The Fisherman. Autumn 1973

FISH SMOKING EXHIBITION

Attachment to 1973/7

Continuing...

A GENERAL SUMMARY OF WORK DONE ON THE MECHANIZATION OF SMOKE KILNS SINCE 1929

By

Patrick Parrish,
New South Wales State Fisheries

Patrick Parrish

In a previous article in this magazine (summer, 1971–72 issue) an attempt was made to show that the prime purpose of fish smoking had expired in the mechanical hands of the Industrial Revolution. For thousands of years fish had been dried, salted, and smoked as a protein investment against an uncertain future, with only a lunatic few concerned about the taste. But from the eighteenth century travel became faster, people inland were in striking distance of the coast, and the demand for fresh fish chopped a big hole in the smoked fish venders baskets; the advent of canning, and the widespreading use of refrigeration threatened to leave him with only the handles.

The fish-curing industry had to review its role. It had to determine if it still had a market, and if that market could be supplied economically.

As to the existence of a market, it was one of the smaller ironies of of increasingly wealthy society that some of the needs, both economic and cultural, of the caveman became distinguishing features of a twentieth century dilettante. Imitation cave art plastered the walls of the salons of New York and Paris, while the admiring guests daintily munched smoked salmon.

In another part of the social scrum were people who had, over many generations, acquired a taste for the tang of salt and acrid smoke. However, although these people were still bidding in the market place, their taste had become milder, more sophisticated. They looked for a predictable breakfast kipper, and not a gastronomic fight with a dark and unknown quantity.

To the commercial curer the smoked salmon eaters were relatively unimportant (for the bored few who want smoked salmon on the top of Ayers Rock, or the surfeited few who yearn for tranquillizers pounded from roots gathered on the Virgin Islands, there is always a specialist caterer; if the money is there).

But the second group, the kipper, buckling and finnan haddie addicts, is very much greater in number, and here is the technical challenge: To cut the costs of production, and still satisfy the customer. If some satisfactory method of mechanization could be developed to save the time and the labour employed, it would not only mean money in the pocket of the boss, but it would also be a humanitarian relief to the men employed to leap about in the smokehouse changing the hanging of the fish, until, with brown paper skin and raw, red eyes, they came to look like something out of the Book of Revelations.

And so, the specialists moved in.

What were the best temperatures for a cold smoke? At what temperature did the fish begin to "denature" and become a "hot" smoke product? What was the ideal relative humidity? What keeping quality could the product be expected to have—especially in view of the very much milder cures employed? What dependency was there between the quality of the finished cure and the condition of the original fish, the season it was caught, the salt used in the brine, the wood used in the smoke?

Biologists and biochemists studied the fish from its death throes to its ultimate, putrifying dissolution. Chemists studied salt and the composition of smoke. Physicists and engineers got into bolts over the speed of travel and the rate of deposition of smoke, and statisticians set up enough taste testing panels to have frightened off Lucretia Borgia.

What had once been the co-ordinated process of a master curer became more like a three-legged race between groups of manic depressives.

There were, however, some centres where the tracks of these races were being recorded and where programmes were being prepared in which all that seemed significant was incorporated. The Research Foundation, in Halifax, Nova Scotia, the Politechnika Gdanska, in Poland, and the Torry Research Station, of Aberdeen, were the three most deeply involved, determined and optimistic.

The general proposition which most closely outlined the aims of the research was probably best expressed by Professor Damazy Jerzy Tilgner, of Gdanska:

"Proper smoke-curing requires rigid control of all thermodynamic and physico-chemical conditions which influence the composition and amount of curing smoke and its colouring and flavouring value."

That it took Torry Research Station, which was the leader in the field, from 1929 to 1939 to produce a kiln giving consistent control of all the variables is indicative of the complexity of the problem.

Fish-smoking falls into two main categories—hot and cold. Some, mainly from the United Kingdom, like it cold; some, mainly from Europe, like it hot.

The mechanical kiln is designed to cater for both tastes. Torry Research Station describes the kiln:

"In effect a simple wind tunnel operated by an electric fan into which smoke can be drawn from the external smoke producer. Fresh air can also be sucked into the kiln and portion of the wet smoking air mixture can be blown up the chimney. Heaters, usually electrically operated and thermostatically controlled, are used to maintain the temperature of the smoke circulating in the kiln."

The description of the kiln as a simple wind tunnel is something of an understatement for it satisfies

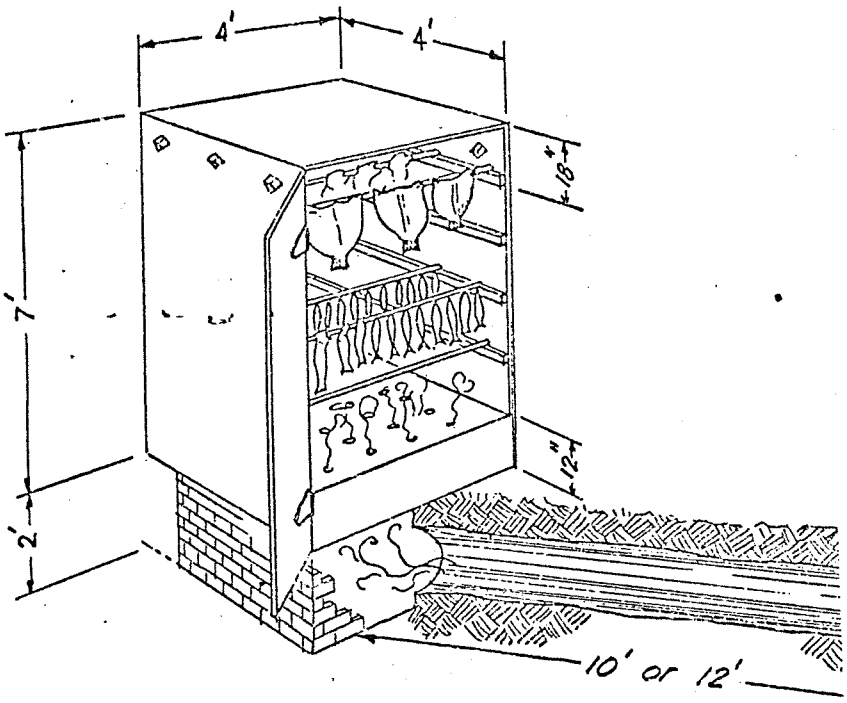


Figure 1: "Do-it-yourself" professional

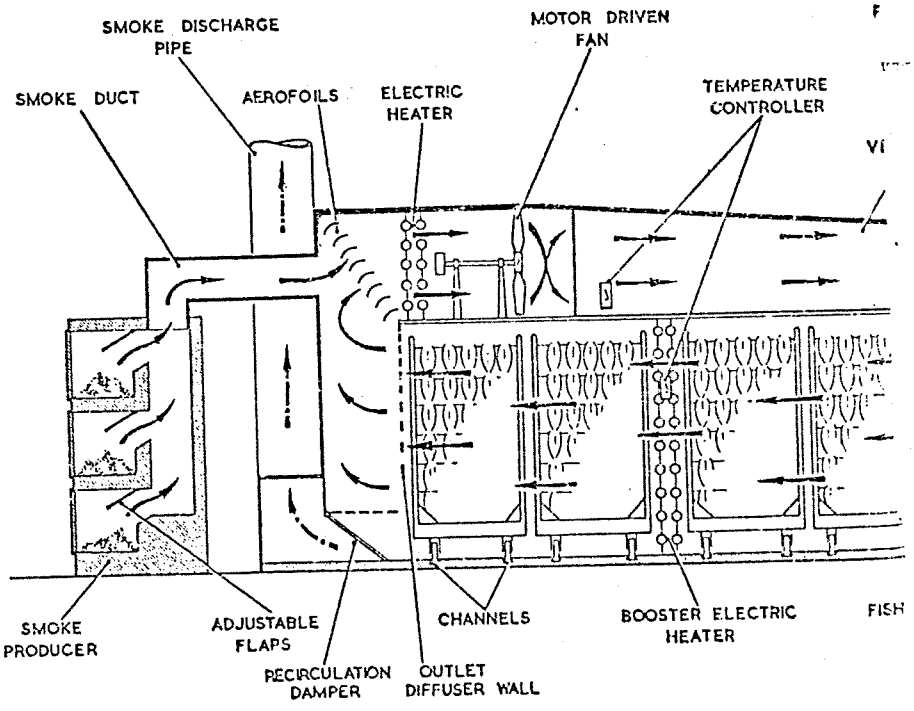


Figure 3: Sectional view of Torry kiln and smoke producer

Professor Tilgner's prescription for "rigid control of all thermodynamic and physico-chemical conditions."

The speed of travel of the smoke is regulated to give the desired deposit in the time during which the fish will have dried to a predetermined per cent. For example, a cold-smoked kipper is considered most succulent when it has a dehydration loss of about 12 per cent.

The speed of the smoke can be calculated by dividing the cross-section of the kiln against the cubic foot delivery of the fan. There is, of course, a rapid drop in the speed when the fish in introduced.

In practice it was found that smoke entering a kiln at 600 ft/min was slowed to about 200 ft/min on striking a kiln packed in the proportions of about 2 lb to the cubic foot. This last figure is considered the most suitable for fully controlled production. Torry gives the following guidelines:

150 lb kiln geared at 250 ft/min
700 lb kiln geared at 400 ft/min
1,600 lb kiln geared at 600 ft/min

As the smoke leaves the fan it not only picks up considerable speed, but a strong revolutionary motion which would lead to uneven deposits in different parts of the kiln. To counter this, adjustable vertical and horizontal aerofoils are set up which straighten out the smoke before it hits the fish. Between the hanging of fish, usually on trolleys built to the dimensions of the kiln, there is a booster electric heater which is thermostatically set for either hot- or cold-smoking.

Torry Station, probably because of traditional national patterns, appears to have done more work on cold-smoking. The critical temperature at which the fish begins to cook is in the range of 85° to 90°F. Above this temperature it becomes a hot-smoke.

From 90° to about 180°F the fish is said to be denatured. That is, there is a physical breakdown in the protein, but there is no chemical change.

From 180°F:

"There is a chemical breakdown of protein molecule which causes a significant change of the flavour profile with the appearance of an unfavourable sulphide note . . . the adverse influence of higher temperatures affect the metabolizable value of the proteins and produces a detrimental effect on the nutritive value of the finished product."

This is true, not only of fish, but of meat and, for people whose palates go beyond the bounds of burnt barbecues and warm, wet pies, the figure of 190°F should be branded in burning Kirsch across their gastronomic psyches. This writer remembers smoking an 80 lb pig for 24 hours with the temperature never above 150°F. I found the result stirred unexpected depths of atavism in usually sedate company. A roast pig alongside, untouched and dried, looked reproachfully over its mouth full of apple.

The Gdanska group, under Professor Tilgner, using a Torry-designed kiln, published significant work about the nature of hot-smoking. Using a photoelectric cell, and applying Beer's Law on the absorbency of light, the density of smoke in the kiln was related to the deposit of smoke on the fish. Taste tests were then carried out to determine acceptability limits

It was found that in flavour the highest scores were between 3·75 mg and 6·29 mg per 100 g of fish.

To make things tricky for the marketing lads it was then found that the fish with the best appearance had deposits of between 12·95 and 24·3 mg per 100 g of fish.

An interesting set of figures in that, among other things, it shows how much more acute the taste is than the sight. Indeed, other research has shown that human taste can draw distinctions beyond sensitivity of the gas chromatigraph. In the realm of the fish merchant it is a barber's cat to all the computer world.

Professor Tilgner set out three physico-chemical criteria:

(a) **The partial drying of the product to remove 15 to 30 per cent of the water content, and to improve certain quality characteristics of the product.**

(b) **The thermal denaturation of the raw protein, resulting in the acquisition of full palatability of the tissue.**

(c) **The smoke-curing of the product in order to change its flavour and improve its storage value.**

This work was carried out in Poland in the 1950's. In Poland there would be greater emphasis on the preservative angle than in the West, where there is much wider use of refrigeration.

Torry cold-smoke recommended 12 per cent loss of weight against up to 30 per cent in Poland. It could well be that the deposits of smoke listed as acceptable in Poland would seem like the first shots in chemical warfare to our less rugged palates.

Apart from the problem of drying and the related problem of heat control, which in turn is related to the rate of smoke deposit, there is the fourth variable of relative humidity. It is this last which could most influence Australian curers to decide on a hot-smoke technique.

Torry has recommended a relative humidity of about 65 per cent for the cold-smoke. This could be a difficult goal where the ambient relative humidity can frequently rise to 90·7. However, if the temperature in the kiln is allowed to rise for a hot-smoke, there is a corresponding drop in the relative humidity. The alternative would be to drop the relative humidity of the air before it is drawn into the kiln, which on a hot summer's day could have an initial temperature higher than that of the kiln, and the value of effort put into this must be weighed against the results.

Possibly the most spectacular and immediately economically entrancing features of the kiln was the speed of production, and that all products were consistent.

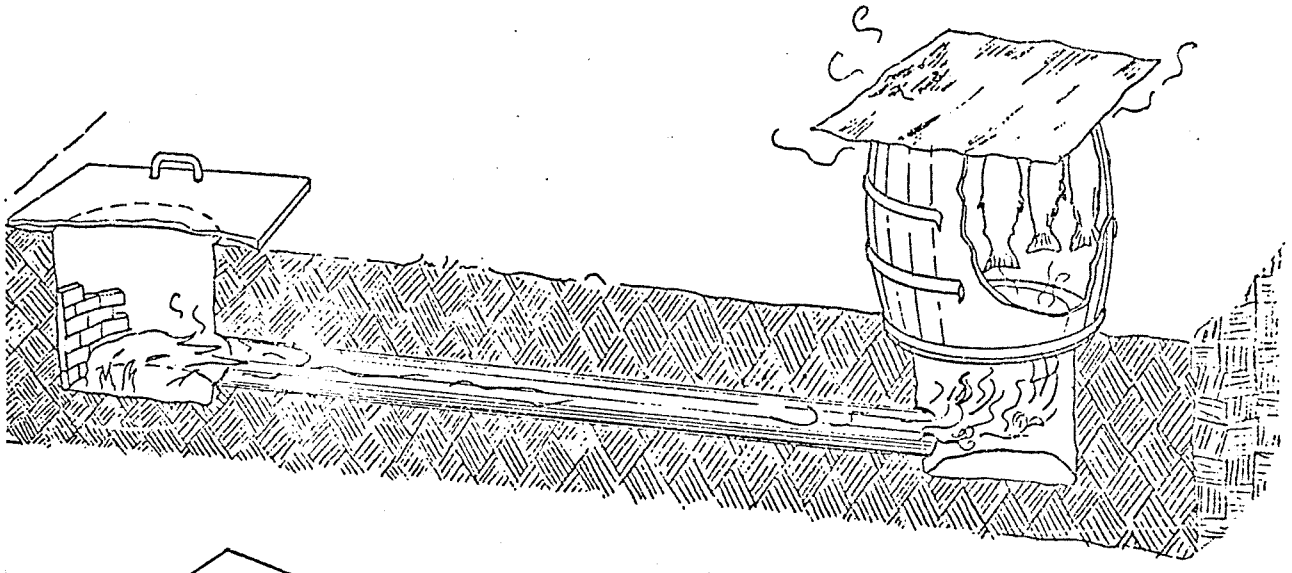
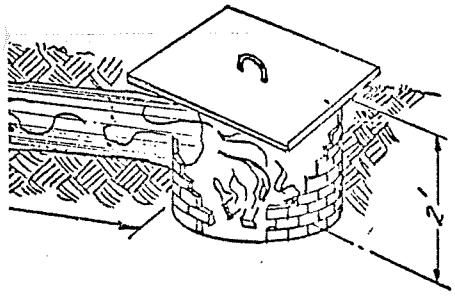


Figure 2: Barrel-type smoke house



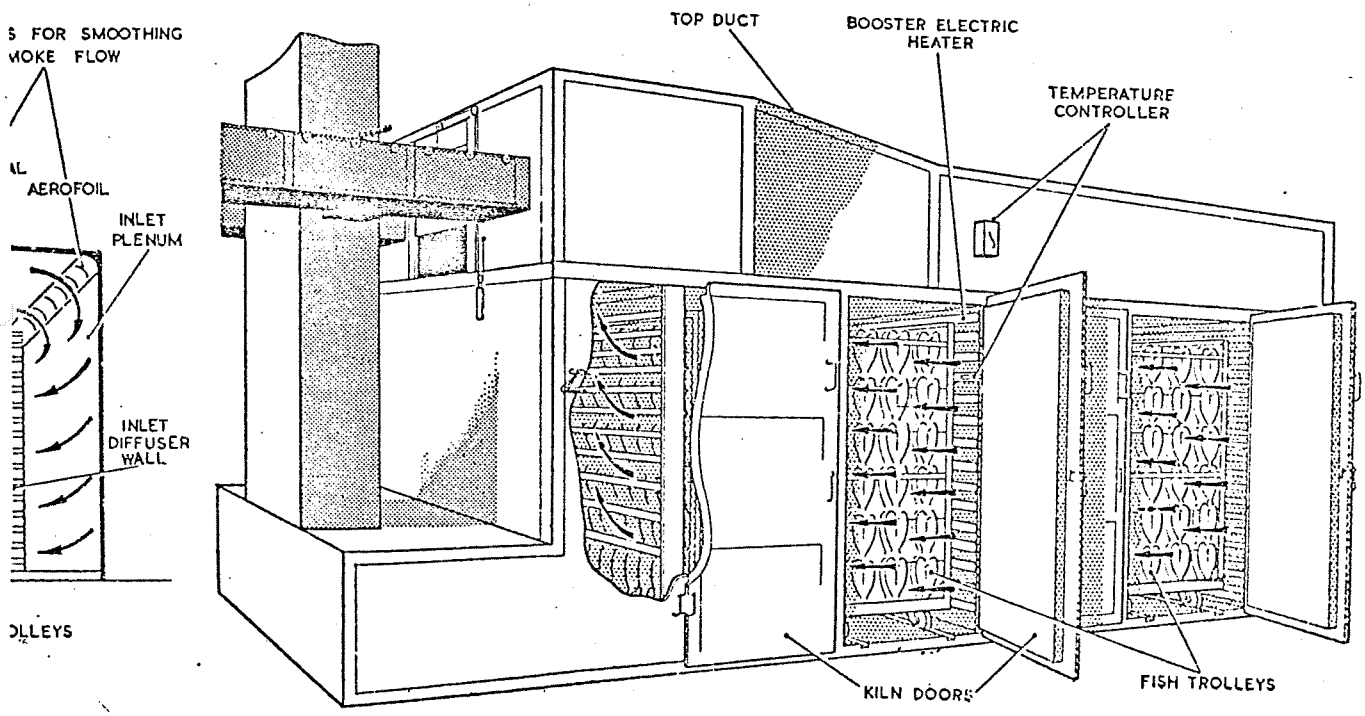


Figure 4: The smoke curing chamber in a Torry kiln

This was the functional end of 10 year's work. A kiln which could turn out a uniform product in one-half to one-third the time of the black hat smokehouse which took up less space and required less labour to operate—and was not subject to the vagaries of the weather.

I have tried to restrict this article to the mechanics of smoking, but the fundamentals of processing a good smoked fish should be scrawled in large letters on the smoky walls of the kiln. No amount of salt or smoke will turn a second quality fish into a first rate smoked product.

At a future date I would like to detail some of the processes of deterioration which can be delayed by skilled handling.

From the moment the fish hits the deck there is more action every minute per square inch of flesh than there has been in Madison Square Garden in the last 20 years.

The enzymes start chomping the cells around them and the bacterium wait ready to begin a breeding chain which makes the World's population explosion look like a study in sterility.

Rigor mortis sets in and the tension can tear the flesh leaving unsightly "gapes" at resolution. The salt in the curing may harbour hordes of misfit bacterium which revel in the stuff, and the freezing of the fish at different temperatures may contribute to a fractured appearance, or a tough and fibrous "chewable product".

Most of these traits can be prevented with both economic and aesthetically pleasing consequency.

One final piece of evidence in favour of the mechanical smokehouse:

In 1969, P. E. Doe, of the T.R.S., published a "Mathematical Model" of the Torry Kiln.

Exhausting most of the letters of two alphabets to cover the number of variables, the paper looks impressively incomprehensible, but the careful and painstaking work concludes:

"The reasonable agreement between the actual and computed behaviour of the drying situation gives encouragement that the model will produce a reasonable prediction of many drying processes with similar geometry to that selected for the model."

Reference:

Bain, Nora *et al.* "The Bacteriology of Salt used in Fish Curing", T.R.S., H.M.S.O.

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Liston, J. and Shewan, J. M. "Bacteria Brought into Brines on Fish", International Symp. Fd. Microbiology, Proc. 2, 1957.

Porter *et al.* "Fractionation and Study of Compounds in Wood Smoke".

Tilgner, D. J. "A Rational Procedure for the Hot Smoke Curing of Fish", *Food Manufacture*, August, 1957.

Acknowledgments:

The publication *Smokehouses and the Smoke Curing of Fish*, Washington State Department of Fisheries, 1969, for figs 1 and 2.

A Torry Kiln Operation Handbook, H.M.S.O., 1963, for figs 3 and 4.

SMOKING

Product	Species used	Type	Time (in hr)		Weight loss by drying on trimmed weight per cent	Yield of smoked product per cent of landed weight	Approximate composition		
			Old kilns	Torry kiln			Water per cent	Fat per cent	Salt per cent
Bloaters	Herring ..	Cold-smoked over billets of wood so as to give heat rather than smoke.	12	3	6	85–90	55	15–20	2–3
Kippers	Herring ..	Cold-smoked over sawdust fires.	6–18	4–6	15–20	65	55	15–20	2–3
Buckling ..	Herring ..	Hot-smoked in a dense smoke.	3–4	2–3	20–25	75–80	55	15–20	2–3
Smoked eels ..	Freshwater eels	Hot-smoked in a thin smoke.	3–4	1½–2	(1) 10–15 (2) 20–25	65	40	30	4–6
Smoked salmon..	Salmon ..	Cold-smoked using proportion of juniper wood.	24–36	9–12	10	70	55	20	5
Smoked roe ..	Cod or ling ovaries.	Cold-smoked ..	12	8	20–25	65–70	60	3	7

Continuing . . .

NATURAL TROUT REPRODUCTION

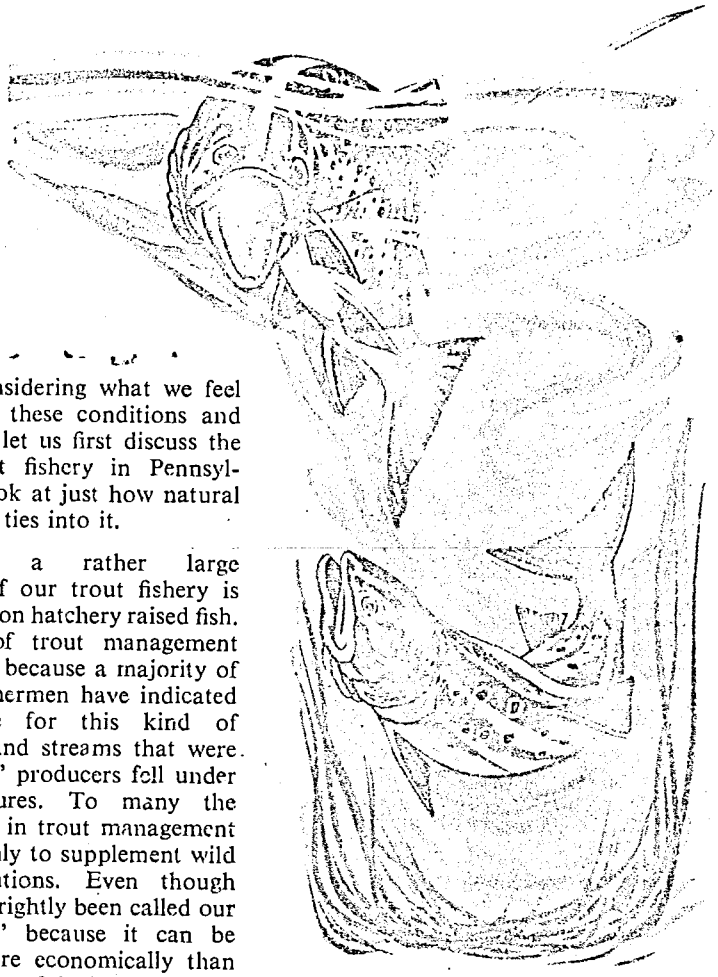
PART II

By

Bob Hesser,

Aquatic Biologist,
Pennsylvania Fish Commission

This article first appeared in the June, 1971 issue of the *Pennsylvania Angler*. Part 1 of the article appeared in our summer, 1971–72 issue.



In the first article of this series on natural reproduction of trout we defined the term as that process through which a species of trout *in the wild* regenerates its own kind. The implication would seem to be that this activity is at its best without man's influence or interference and therefore if man's influence on many of our waters were to be curtailed, natural reproduction could conceivably provide all the fish needed for our trout fishery in Pennsylvania.

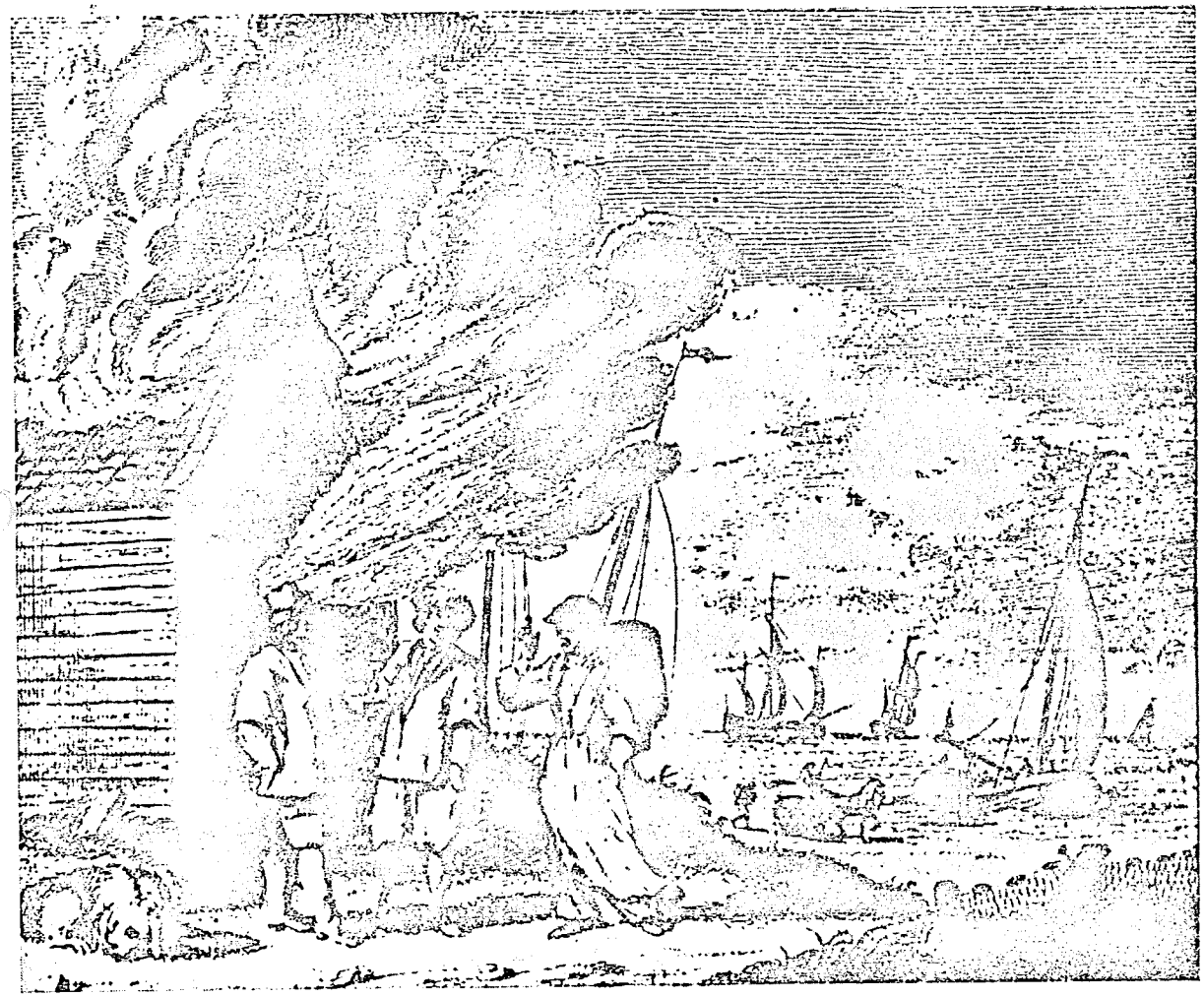
But before going off the deep end, let's explore what would really happen if all our waters were suddenly to return as they were in the year 1671? Would all of our stocked waters contain native brook trout? Would many we do not now stock contain trout? Before you decide what answers you will give, consider the several million people now inhabiting the watersheds of the streams. What would these people have to do that their forefathers didn't do, or vice versa, to preserve just the trout waters alone? Remember, Governor Shapp's question contained the phrase "improve conditions for the natural reproduction of trout."

Before considering what we feel are some of these conditions and their causes, let us first discuss the present trout fishery in Pennsylvania and look at just how natural reproduction ties into it.

Currently, a rather large percentage of our trout fishery is dependent upon hatchery raised fish. This form of trout management evolved both because a majority of our trout fishermen have indicated a preference for this kind of programme and streams that were once "native" producers fell under man's pressures. To many the ideal concept in trout management is to stock only to supplement wild trout populations. Even though the trout has rightly been called our "instant fish" because it can be produced more economically than any other game fish, if we were to stock trout only to supplement wild trout populations, what would happen? One thing is certain. Many of our present "trout streams" would no longer fit this classification. To some this might be the greatest "advance" in trout management to ever hit Pennsylvania, but if we are to manage *all* of our waters some programme must be designed for our marginal streams, or those which have no wild trout to supplement. What can be done with the Wissahickon Creek, near Philadelphia, or Deer Creek, near Pittsburgh. Both are examples of so-called put and take streams that have been the topic of discussion among fishermen for many years. The point to remember here is that no matter how one feels about such streams, they are borderline because the water quality makes them that way. To manage them for any other type of fishery is nearly impossible. By stocking them with trout—call it "put and take" if you wish—a fishery is provided at a relatively low cost in areas where little or no trout fishing is otherwise available.

By now our Governor's words should be taking on some new, or at least different, implications for you. Why are such streams as the Wissahickon Creek, Spring Creek (Centre County), the *lower portions* of the First Fork of the Sinnemahoning Creek and Big Pine Creek marginal streams for trout? The First Fork and lower Big Pine marginal? They are, and for reasons different from the Wissahickon and Spring Creek.

Were the Wissahickon and Spring Creek as free of the influences of man as the other two we've mentioned, natural reproduction and fishing in them would be amazing. The point is this—at the present time many of our potentially



Scottish smokehouse, early 1800s

Getting The Good Smoke Taste

by Patrick Parrish
N.S.W. State Fisheries

The first instalment of a two-part article in which Patrick Parrish tells how to build a smokehouse suitable for the smoking of from thirty to forty pounds weight of fish

Smoke-curing of fish is older than recorded history. River fish, either sun-dried or dried over fires in dark, smoky caves, were a much more accessible source of protein than the flesh of the feral beasts of the forest. It is also no accident that the earliest civilizations developed along the banks of tropical and subtropical rivers. Fruit and berries, fish stranded by the late summer drought and drying in the sun, and man sheltering in caves during the winter with tastes less fastidious than ours, led to the oldest of all technologies: the study of food preservation.

It is this study and its application to the preservation of fish which is the subject of this article.

Theory and Practice

The theory behind smoke-curing was that by dehydration, by salt and by smoke, the processes of deterioration could be arrested or delayed.

Logically, if fish were treated to the ultimate of these three processes —with total dehydration and maximum salt and phenol adsorption—they should be immune to chemical and bacterial onslaught, on the other hand they would be particularly unpalatable to eat. However, by juggling the three treatments it is possible to strike a balance between the function of preservation and palatability.

An important, if obvious, injunction is that no amount of smoking or salting will produce a good finished product if the fish is not fresh and in good condition. There is a vague belief that stale fish can be rescued by a sufficiently strong cure, and although it might be possible to disguise the initial deterioration, it is, at the best, only a very temporary measure, for once the fish has started its march to inevitable putrefaction any product contrived from it will be unpleasant.

Smokehouses

The earliest smokehouses were caves. As man became more manipulative his ability to change his environment increased and where there were no caves he built the first primitive houses. The houses were by rivers: for water, for wild fruits and berries, and for fish. As he had used his cave to smoke his fish, he so used his primitive house. Even in modern times there is a linguistic continuity in the term smoke-house. In classical Greek "smugenae" means to smother with smoke. Old High German has "smoock-hus", and Old English "smoka-hus".

The simple type of backyard smoker is much the same as the smokehouses of our early ancestors. Smoke from burning wood drifts up to the brined fish hanging above. To ensure more smoke the fire is doused with water, leaving only the glowing ember. But constant care is needed to prevent the flaming and overcooking the fish. Where care is taken there is still such an uneven distribution of heat that it is almost impossible to produce a consistent product. At this point a variation in construction can be introduced to provide a greater control and a choice of aims. By removing the source of smoke in the kiln it is then easy to achieve, by the addition of heaters, a constant and controllable temperature in the kiln which will produce a predictable, hot smoke.

Building the Smokehouse

The smokehouse described here is suitable for smoking thirty to forty pounds of fish calculated on the basis of two pounds of fish to one cubic foot of kiln space.

The materials needed are ¼-inch Pyneboard, rectangular galvanized iron downpipe, firebricks, 3 x 2 inch hardwood, some good external paint, and epoxy resin of "Bondcrete".

The smokehouse proposed is:

5¼ ft long

1½ ft wide

2¼ ft high

(if this is to small, any increase in size should be made with a proportionate increase all round).

Material for Smokehouse:

2 pieces 5¼ in x 2¼ in x ½ in Pyneboard.

2 pieces 5¼ in x 1½ in x ½ in Pyneboard.

2 pieces 2½ in x 1½ in x ½ in Pyneboard.

Trays:

8 pieces 5 ft x 1 in x ½ in.

8 pieces 1½ ft x 1 in x ½ in.

This will provide four trays of 5 ft x 1½ ft and one tray 2½ ft x 1½ ft, spaced 4 inches apart. The materials for the trays should be of hardwood.

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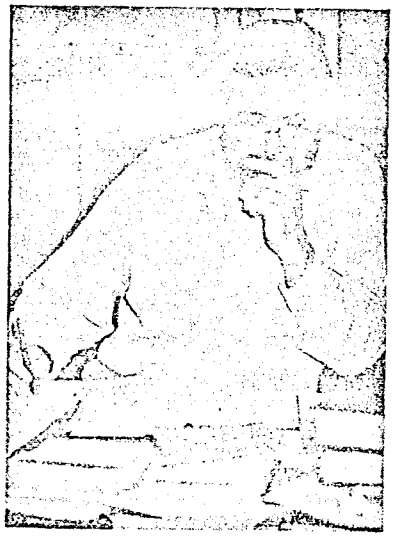


Patrick Parrish

Getting the Good Smoke Taste

Continued from page 2

Runners to support the trays:

8 pieces 5 ft x 1 in x ½ in.

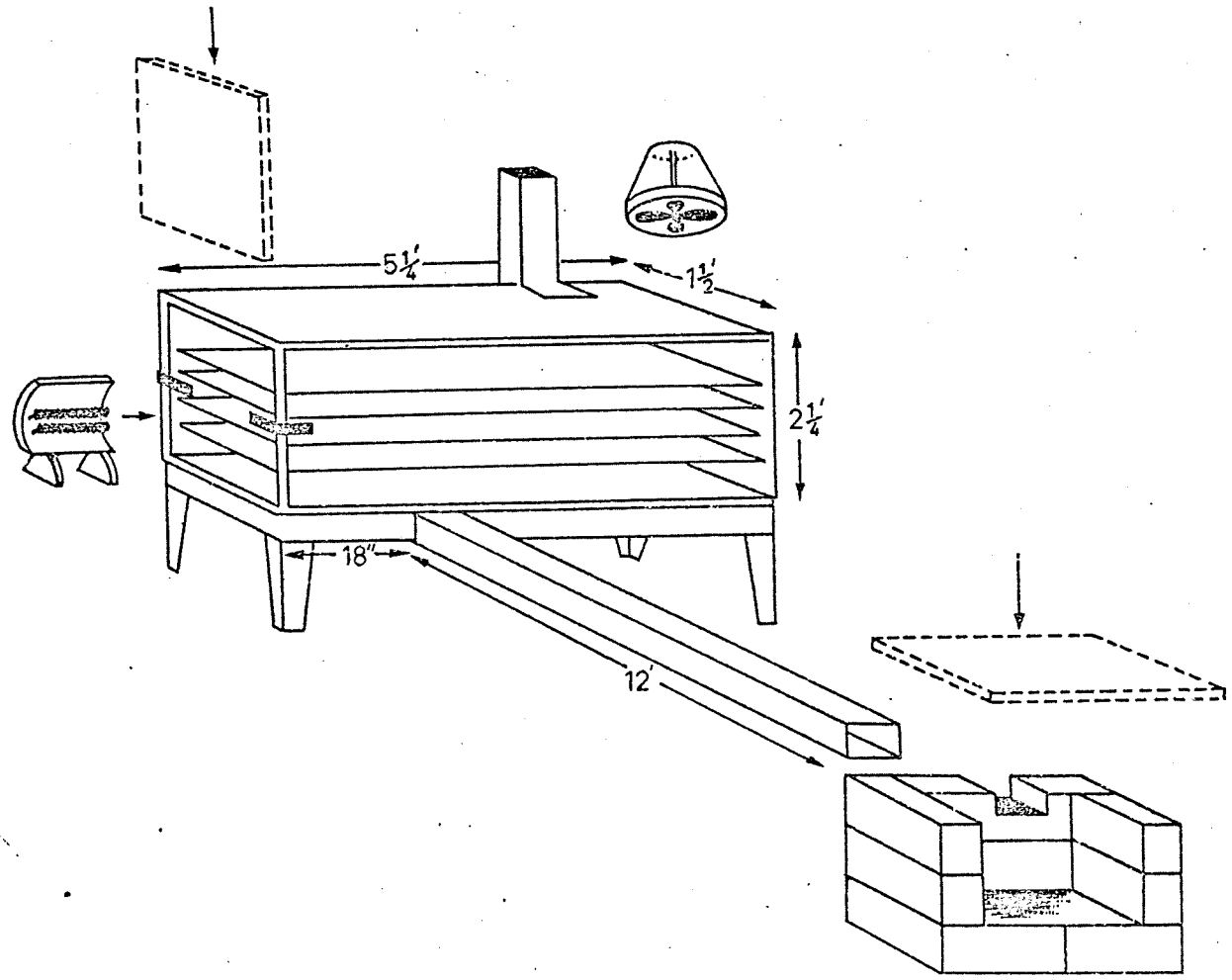
2 pieces 2½ ft x 1 in x 1½ in.

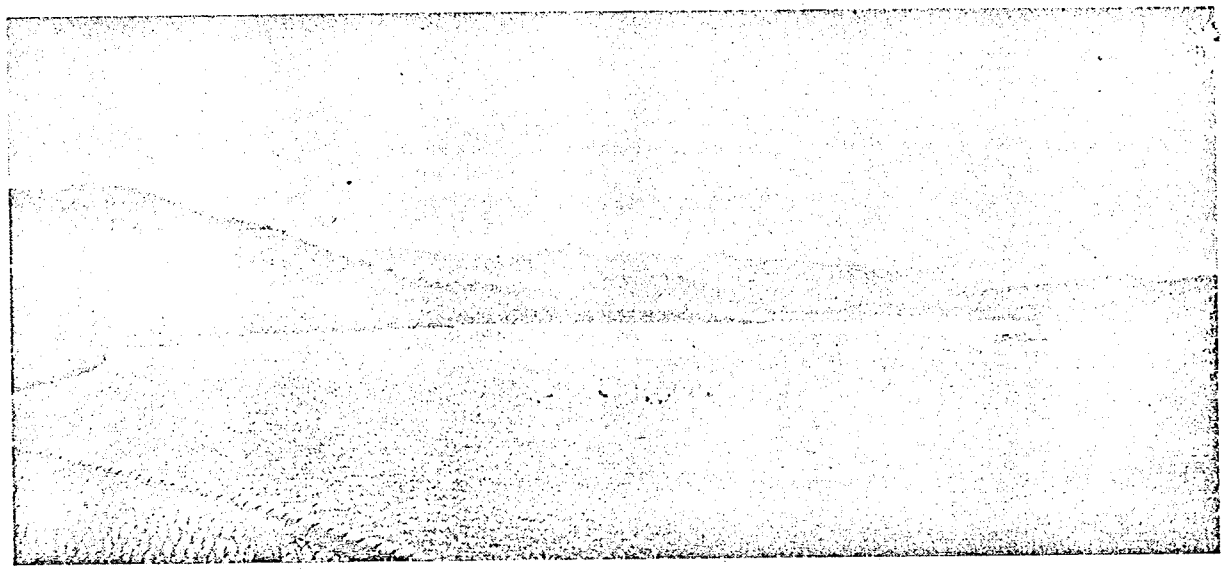
The trays should be covered with ¾ in mesh, 33¾ square feet being required. There are some good nylon-based meshes available which are preferable to galvanized iron. The latter is likely to rust and cause damage to the fish.

The kiln is mounted on four legs of 3 in x 2 in hardwood, 2 feet long.

The galvanized pipe leads from the smoke pit to the kiln on a fair rise to ensure the smoke flowing up to the fish. Leading from the kiln (see diagram) is a 12-foot-length of 4 in x 4 in galvanized iron downpipe. The other end of the pipe is anchored into the smoke pit. One end of the kiln is left open for the door (1½ ft x 2¼ ft). The door can be held in place with two pieces of ¼-inch strip steel bent at right angles and bolted to either side of the kiln. Two wooden wedges will hold it in place. Eighteen inches from the door, at floor level, a 4 in x 4 in opening is cut to accommodate the 12 feet length of downpipe. On the roof of the kiln, at the opposite end to the entry hole, is cut a similar opening of the same dimensions. This can be provided with a flap to regulate the amount of smoke leaving the kiln.

The inside of the kiln is painted with a good brand of Pyneboard sealer such as Bonderete, and then coated with a thick layer of epoxy. The epoxy is not only a preservative, but its use also makes the interior easier to clean. The outside of the kiln should be treated with a good brand of external paint. These preservative coatings can, of course, be applied more easily before the kiln is assembled. Care taken at this time in the building should give the kiln a life expectancy of some 10 years.





Wyangala Dam

TROUT SEASON DRAWS TO CLOSE

The trout season in most of the State's trout fishing areas opened on Saturday, September 30, and will close on Sunday, June 3, 1973.

This was announced recently by the Chief Secretary, Mr I. R. Griffith, who said that the trout season on the tributaries of Lake Eucumbene which had commenced later than usual: Saturday, November 4, will close on Sunday, July 1, 1973.

Earlier in 1972, the close season on the Lake's tributaries was put back 2 months so that brown trout, which had built up to undesirable numbers, could be taken during the spawning run.

This move gave added protection to rainbow stocks which tend to spawn later than the browns.

The open season in the waters of Fish River Creek and Racecourse Creek and their tributaries from the backed-up waters of Oberon Dam closed on Sunday, April 29, 1973. Downstream from the dam, the general open season applies.

Mr Griffith said year-round fishing was permitted in the following localities:

The backed-up waters of Lake Eucumbene; Wyangala Dam, near Cowra; Burrunjuck Dam, near Yass; Hume Weir, near Albury; Ben Chifley Dam, near Bathurst; Lake Jindabyne; Oberon Dam; Blowering Dam; Manly Reservoir; Wentworth Falls Lake; the Clarence Dams, near Lithgow; and the Tantangara Reservoir, near Kiandra. Anglers in the Clarence Dams, Lake Jindabyne, Oberon Dam, Manly Reservoir, Lake Eucumbene, Wentworth Falls Lake, Tantangara Reservoir, and the Ben Chifley Dam, are confined to the use of methods lawful for the taking of trout.

Narrandera-raised Fish for Farm Dams

Scientists working at the Inland Fisheries Research Station at Narrandera have succeeded in producing warmwater indigenous fishes for landholders to stock in farm dams.

This was announced recently by the Chief Secretary the Hon. Ian Griffith, M.L.A., who said the Station's pilot fish breeding programme had been financed by a special grant from the State Government.

The programme followed a great demand from farmers, and more than 55,000 young Murray cod, golden perch, and catfish from the Station have been sent to property owners with farm dams.

Mr Griffith said that he had been advised by the Director of State Fisheries, Dr Francois, that most of the rural properties in New South Wales have farm dams —many of which are too warm for trout.

The Chief Secretary said the pilot programme had used newly developed breeding techniques such as the use of fertility hormones. Because of this, a boost in the production of young fish in future breeding seasons is expected.

Mr Griffith stressed that although the Inland Fisheries Research Station is operated from revenue obtained from inland angling licences, all costs associated with the breeding programme are being met by a special State Government grant.

The Smoke Producer

There have been many attempts to design and manufacture automatic smoke producers, but, up to the present, the traditional primitive method is the one most widely used. This is even so in advanced, large scale commercial enterprises.

To serve this particular kiln a hole is dug in the ground 12 feet from the inlet in the kiln which takes the galvanized iron pipe. The hole is lined with fire bricks on three sides. The dimensions are two fire bricks long, i.e. 18 inches, and two bricks deep, i.e. 9 inches. The centre side of the three sides has one half of one top brick cut away, this is to take the open end of the galvanized iron pipe. The floor of the pit is made with more fire bricks and the whole pit should require about twenty bricks. Across the top a hinged piece of asbestos board is laid to form a flap halfway down the open side of the pit. The bottom half is left uncovered to allow an air draught to keep the fire smouldering.

The fire itself is made of about 1 inch of shavings covered with 2 inches of sawdust. The shavings act as an aerator to prevent the sawdust from falling in on itself and smothering.

As to the sawdust to be used, there is a great deal of folklore, but, in general, almost any Australian hardwood gives a pleasant, tangy taste.

Soft woods, such as oregon, should be avoided, for, although they might impart a pleasant golden colour to the finished product, they may also add an unpleasant varnish-like taste.

The method described so far has been for cold smoking, and by using the equipment recommended about 10 to 12 hours would suffice to smoke a fish of between 2 and 3 pounds in weight.

Equipment for the kiln

There are two principal methods of exposing the fish in the kiln to treatment by smoke.

The most common practice is to hang the fish by its flaps to "tenters" attached to cross beams in the kiln. The second method is to lay the fish on trays which can be slid on runners into the kiln; the runners also serving as supports for the beams holding the tenters.

The tenter hooks are made of steel in the shape of a figure "S" which will fit through the wings of the split fish and over the beams. The beams are made of 1 in x 1 in hardwood 18 inches long.

Trays for this kiln are made from 1 in x $\frac{3}{4}$ in mesh "Nylex Sarlon" fastened by staples to the frames of the trays which are made of 1 in x $\frac{1}{2}$ in finished hardwood.

Trays are generally used if it is intended to smoke the fish as fillets, and, indeed, in a hot smoke it is almost essential to smoke fillets on trays to prevent the fish from falling from the tenter hooks.

The other advantage of the trays is that should it be necessary to smoke a quantity of fish for the purpose of preserving it, the fillets give a much better return than the whole fish as considerably less space is required to store fillets. The hanging of fish on tenters is, of course, preferable if the fish is to be smoked whole, or in the traditional kippered method.

General Summary

The kiln is a true cold-smoke kiln, as the source of the smoke has been removed from the kiln itself. This not only prevents scorching, but also obviates the necessity of watching the fires, or building a smokehouse big enough to offset any burning of the fish if the fire flares. The advantage of this particular design is that it can be converted into a hot smoke kiln possessing a high degree of control, for little additional expense, and without structural alterations.

Hot Smoking, and Additions to Kiln

In the illustration it will be seen that there are four full-size trays each 5 ft x $1\frac{1}{2}$ ft, and one tray $2\frac{1}{2}$ ft x $1\frac{1}{2}$ ft. The half-sized tray is designed to run on the bottom set of runners, and when in use slid to the back of the kiln. Space remaining is for the installation of a single-bar radiator. On the right of the radiator, the bar is covered with a piece of curved metal to protect the radiator from droppings of fat. In larger kilns it may be necessary to use a higher output heater to get sufficient heat to cook the fish.

The radiator should be switched on during the last two hours of cooking, during which time the temperature should rise to about 180° F. A thermometer hanging on the inside of the outlet vent will provide adequate temperature indication for the backyard smoker. For commercial operators, the installation of a mercury thermostat would be worthwhile and not be costly.

For best results, it is essential that the temperature should not rise higher than 190° F. Above this temperature a chemical change takes place, causing a protein breakdown which affects both the taste and the nutritional value of the fish.

The radiator should be so placed that smoke entering the kiln flows directly across its face. This, as well as heating the smoke, causes a faster flow of smoke through the kiln and shortens the time of the smoking process.

The Torry Research Laboratory established the importance of speed of flow of the curing smoke in a forced-draught kiln, which had dramatic results on the industry. Smoke times were reduced to one-half or one-third of the time by speeding the flow during traditional smoking, and because of the constant smoke movement a considerably more uniform product resulted, with much less need for re-arranging the fish in the kiln during the smoking process. By the addition of an exhaust fan to the outlet of the kiln during the smoking process the same conditions can be duplicated in the backyard kiln, with the same time-saving results.

The following table is for hot smoking, using an exhaust fan and heater in the kiln.

Fish	Brine % by sal. reading	Smoking time hot with fan on	% weight loss
Mullet, gutted and split vertically along the cavity to the backbone.	10 mins 80%	1 hour without heater + 2 hours with heater switched on.	20
Tailor, gutted and split as for mullet.	7-8 mins in 80% brine	1 hour without heater + 1½-1¾ with heater.	18-20
Trout Filletts*	Dry-brine 2 hours	1½ hours without heater + 1½ hours with heat.	17-20
Hake fillets*	Dry-brine 2 hours	1½ hours without heater + 1½ hours with heater.	18-21
Mullet fillets	5 mins 80%	1 hour without heater + 1½-1¾ hours with heater.	18-22
Commercially farmed trout weight approx. 12 ozs filletted.	2 mins 80%	Smoked at 100° F for 80 minutes.	17-20

To be concluded. In the next issue of *The Fisherman* Patrick Parrish will talk about the preparation of smoked fish for the table.

The Redfin Episode

Continued from page 4

to the extreme detriment of the trout fishery. In fact, very few trout are being taken and the lake can no longer be regarded as a trout fishery."

Towards the end of 1969 it was obvious that urgent remedial action was necessary to correct a rapidly worsening situation.

It is common practice in many parts of the world to rid normally good fishing waters of undesirable "trash" fish by the use of a selective fish toxicant possessing a limited period of effectiveness, usually a biological extract acting upon the respiratory organs of the fish. Later, when sufficient time had elapsed for the preparation to become detoxified, the water could be re-stocked with desirable fish. The treatment is completely harmless to humans.

This was the method advocated by Dr D. D. Francois, who recommended a rotenone- (derris or cube) based preparation called Chem Fish Regular. The preparation is toxic to most fish in concentrations of less than 0·5 part per million, and it was estimated that about 80 gallons would be sufficient to destroy the existing fish population in the lake.

As Lake Canobolas supplies water to five properties in the area for irrigation, as well as to the Canobolas Public School's washroom and toilets, and as the lake is also used by tourists, picnickers, swimmers and a local sailing club during the summer months, the matter of using Rotenone was referred to the N.S.W. Department of Health for investigation. Following approval from the Department of Health the proposal was submitted to the Orange City Council.

In January, 1970, the Orange City Council rejected the proposal on the grounds that such a risk to public health, solely for the sake of improving sport fishing, could not be taken under any circumstances. Despite the use of similar methods of control overseas, and under similar circumstances, the Council remained adamant in its decision.

Repeated references in the area press about the Fisheries proposal to "poison Lake Canobolas" did little to reduce the emotion generated over what was in fact a perfectly harmless operation.

While the stalemate continued, trout fishing in the lake declined to a state of virtual non-existence. By early 1972, redfin had infiltrated into Molong Creek, and at the request of the Molong Trout Fishing Club the Molong Shire Council asked the Orange Trout Acclimatisation Society to open Lake Canobolas to all types of fishing. It was apparent, however, that this proposal would not correct the situation. Lake Canobolas was so over-populated with redfins that opening the lake to general fishing would do little to reduce the overall fish population.

Oddly, by a strange quirk of fate, a move by the Orange City Council opened the way to a solution to the problem.

Notice of a proposal by the Orange City Council to lower the lake by several feet in order to carry out necessary foreshore improvements reached the executive of the Orange Trout Acclimatisation Society. Quick to see that this could be a solution to a problem that had existed for 6 years the Society proposed to the Council, and to N.S.W. Fisheries, that the lake be completely drained, and that a small amount of fish toxicant be used in the lower part of Meadow Creek into which water from the Lake flows via an outlet valve in the lake wall. And, said the Society, when the lake was refilled could not it be stocked with trout?

The scheme was examined by biologists of N.S.W. Fisheries, who saw merit in the proposal, and a recommendation was made to the Orange City Council, who also agreed—providing that the draining was completed at such a time as to permit the lake to be refilled and be reasonably full by late spring 1972.

On Tuesday, July 18, 1972, workmen from the Orange City Council opened the valve releasing water from Lake Canobolas into Meadow Creek. For 4 days the water poured from the lake, and

Getting the Good Smoke Taste

by Patrick Parrish,

N.S.W. State Fisheries

PART TWO: BRINES AND BRINING

BRINES AND BRINING

In this article it is not proposed to consider exotic brines of herbs and tinctures, or molasses and rum; we are concerned now solely with salt.

There are two ways of adding salt to the fish:

1. By dredging it in salt and leaving it buried, a layer of fish and a layer of salt alternatively, so that it will absorb, through osmotic pressure, whatever percentage of salt the thickness of the fish and time allow.
2. By making a liquid brine and soaking the fish in it.

The liquid brine method is quicker, and, generally, gives a more uniform result.

The time needed for absorbtion is dependent upon the brine concentration, on the thickness of the fish, and on the requirements of the consumer.

To achieve an even distribution of salt, the fish should be brined in the proportion of 2 lb of fish to 1 gal of liquid brine.

For commercial purposes, it is interesting to note that there is a slight increase in the weight of the fish brined in a solution 50 per cent stronger, and a slight loss of weight in fish brined in solutions of less than 50 per cent.

It is important that commercial curers keep a strict control over storage facilities, and keep the brine tanks scrubbed clean. Australian salt, which is the type known as "solar" salt, is particularly susceptible to halophilic bacteria which cause the unsightly dun and pink spots which, once in the plant, are very difficult to clean out.

Dry salting is most commonly used on large slabs of fish such as ling, hake, 'couta and on imported New Zealand blue cod.

It will be seen from table 3 that the time spent in the liquid brine is quite short, but if the product is still too salty, it is better to reduce the length of the dip rather than to dilute the brine below a 50 per cent salinometer reading.

Patrick Parrish

The salt uptake in the fish begins rapidly and then slows down, with the 2 to 3 per cent thought to be an average desirable content occurring in the first 15 minutes. The uptake is, of course, considerably affected by the thickness of the fish

Adverse brining can occur in fish with thick skins of heavy scales; or a variable result in kippered fish, in which the boneless side will have a greater uptake than the side with the backbone.

For the commercial producer the brining can be speeded up by agitation of the brine, a practice fairly common in large overseas smoke-curing companies. On removal from the brine the fish is either hung on tenter-hooks or put on trays to dry. This drying period has a considerable affect on the gloss of the finished product. It would appear that the best results are obtained if the fish is dried at temperatures of about 45°F, and although this is difficult to achieve in most parts of Australia during the greater part of the year, some drop in temperature can be obtained by drying the fish under the forced draught of a fan. The gloss, called the pellicle, is caused by the swelling of fish protein under the osmotic pressure of the brine. When the fish has become tacky, it is ready for the smokehouse.

These cures are suitable for tailor, mullet, blackfish, seabream and New Zealand blue cod.

stocked were insufficient to provide good fishing. Fortunately a correct stock-policy was easy to implement.

Spawning Populations

Most spawning populations of trout are found in eastern Victoria in rivers with gravel bottoms, both north and south of the Divide, often flowing through heavily forested country. The trout stocks are maintained entirely by spawning. At present we exercise no control over the species or the number of trout produced each year. Neither are we able to improve the habitat, or increase the total stock, which currently varies between 2 and 180 lb of fish per surface acre of stream bed. Surveys revealed that the average carrying capacity of a typical stretch of gravel bottom in stream beds such as the upper Yarra, Howqua or Rose River was from 35 to 45 lb per acre. Most of the trout in the rivers were 1 to 3 years old, with a few older fish.

Many of the fish populations were also characterized by individual fish having a very slow growth rate. In the Yarra, 11-inch trout were from 3 to 5 years old, with the same sized fish in the Broken and Acheron Rivers being 3 years old. The result of this slow growth rate; and high mortality after 3 years of age, was few fish over 11 inches in length (*see* table).

Percentage of trout over 11 inches (old minimum legal length)

River	Percentage of fish over 11 inches long
Acheron ..	5
Yarra.. ..	5
Broken ..	7
King Parrot ..	8
Delatite ..	11
Howqua ..	13
Rose	23

Rivers with a higher percentage of legal size fish, such as the Rose, were also those with the fastest growing trout, fish reaching 11 inches at 2 years old. It appeared that the faster growth rate had raised them over the size limit before they became subject to heavy mortality in their third year of life. However, even though the Rose was carrying a greater number of legal size fish than many other rivers, most of them were still under 1 lb in weight. Only 10 trout, of a total sample of 287, exceeded 1 lb in weight, and of these only 2 weighed 3¾ lb.

Rivers north of the Divide were carrying nearly equal numbers of brown and rainbow trout. The rainbow trout however, were all less than 12 inches in length, although larger brown trout were present.

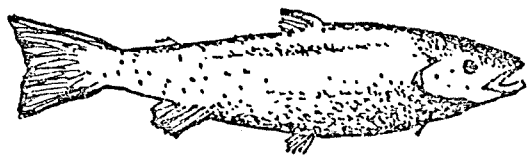
It appears from the larger number of small, slow-growing fish, that the rivers had become overpopulated with trout.

Various surveys, and reports from district Fisheries and Wildlife officers, indicate that the problem of overpopulation is common in most eastern Victorian streams.

The effects of 80 years of bag and size limit and closed season cannot be measured or assessed, as we have no knowledge of the population distribution in past years. Any comments on whether or not the regulations have been responsible for the current situation would only be an opinion. Perhaps changes in the habitat, or fishing pressure, have had the major influences on moulding the populations to their present state. The important fact is that the regulations have not prevented, and were not improving, the problem of the large numbers of under-sized trout. They were also detrimental, in that they were preventing the utilization of large numbers of 2 and 3 year old fish, 9 to 11 inches in length, which were going to be wasted anyway, because of natural mortality. The regulations also protected rainbow trout while they were in the rivers and made them only avilable to the angler just before they were due to disappear. This meant that only half the total weight of fish in the river was available to fill the angler's creel. Protection of fish under the old size limit was only perpetuating overcrowding, a slow growth rate, and a high mortality.

Stocking of trout into spawning populations in Victorian rivers was still carried out as recently as 1969. It has been well established by research in the United States that survival of fish stocked in these conditions is in the order of 1 per cent. This, together with the low number of fish liberated into rivers meant that stocking for so many years had no impact whatsoever on the natual population. For example, the Rose River had received an average liberation of 53 fish per mile each year, over a 10-year period. These 53 fish, weighing 1 lb, were placed into a natural population of 3,000 fish per mile, at a density of 44 lb weight per surface acre. Even if all survived, they were too few to provide better fishing.

We could sum up this section by saying that the only management method which has promoted better fishing in Victoria has been the stocking of trout into waters containing non-spawning populations. Stocking of spawning populations has been unsuccessful. Restrictive regulations have no application to non-spawning populations, and as applied to spawning populations over the past 80 years, have not improved or even maintained the quality of fishing.



For smoking soft-fleshed fish such as hake or trout it is preferable to use a dry brine. Fish to be smoked should first be gutted and thoroughly cleaned. Particular care must be taken to clean out the kidney (which lies along the inside of the belly cavity) from trout. It is then a matter of choice as to whether the fish should be smoked whole, split or filleted.

For reasons, apart from taste, most trout fishermen prefer their catch smoked whole. However, because of the texture of the flesh, it is necessary to adopt special hanging methods to prevent the fish falling to the floor of the kiln.

The fish is put in dry salt with salt packed into the belly cavity. It is then left completely covered for 3 to 4 hours, depending on the size of the fish, and then washed thoroughly in freshwater. To prepare the fish for hanging in the smokehouse, strong twine is passed through the centre of the body and a loop made around the girth with two half-hitches. Further up, the twine is again looped around the body in a barrel hitch and fastened to the further side with sufficient twine to pass over the cross supporting beam. The fish is smoked for 10 to 12 hours to give a pleasant, medium smoke.

Apart from the supreme optimism of people who think that smoke-curing will rescue a fish that is on its way out, there is also the naive optimism of those who think that smoke-curing will confer immortality on a creature that is more prone than most to the transcience of the flesh.

Smoke-cured mullet, have a keeping life of 3 to 4 days longer than fresh fish at 60°F. A mild brine and smoke-cure results in a keeping time of about 1 day longer over that of fresh fish.

If there is fish to store, it should be wrapped when cool in some fairly non-porous material such as "Glad Wrap", to limit dehydration, and kept in the refrigerator. Quality will remain good for about 7 days by this method of storage.

There are various ways of preparing smoked fish for the table but for the normal breakfast menu, the fish will be appetising if poached for 3 to 4 minutes in a shallow pan. Alternatively, if they are fat, oily, fish, they can be put under the griller for 2 to 3 minutes with perhaps a little butter added to keep the surface moist.

Eels and Roe

Eels: smoked eels are of great interest to many Europeans, particularly the Dutch. In recent years the taste has infiltrated to locals and become another "special" in the larder of the budding gourmet.

For the process described here it is important, if starting with the raw product caught in a net, or on a line by accident, to use the right species of eel. Most of the eels caught will be of the family *Auguilla australis occidentialis*, commonly called the short finned eel. It is usually about 2–3 lb in weight and from 18 to 40 inches in length. (A treatment for the larger eels will be described later.)

The eels are at their fattest and best during maturity, when the colour changes from golden to silver.

At certain times of the year, and after drought conditions, eels, like mullet, can develop a muddy flavour. This can sometimes be eliminated if the eels are put into a 44-gallon drum which has holes punched in the side, and freshwater run through for 2 or 3 hours.

Having drained the drum the eels can now be deslimed. This is necessary, both for appearance and to permit smoke penetration. There are two ways of doing this:

1. By stirring the eels in a container with sufficient salt to cover them. The slime rises to the top of the sludge and the eels are then washed in freshwater. Only live eels can be treated in this manner.
2. By freezing. When dead eels are frozen the slime turns to ice and is easily removed.

Care must be taken in gutting, and the belly is slit beyond the vent to make certain of removing all the kidney. The head is left on and the eel is then thoroughly scrubbed in freshwater.

The eel is dipped in an 80 per cent brine for 20 minutes (this is variable according to taste experience and the size of the eel). After brining, it is hung on stainless steel wire, or wooden dowels, pierced through the neck, and put in the smokehouse. Small wooden spreaders are put in the belly flaps to keep the body cavity open and to ensure smoke penetration.

For a cold smoke the eel is left for about 10 hours. For a hot smoke (with a fan) it is smoked for 2 hours at air temperature and for 2 hours with the heater on.

On removal from the smokehouse it is allowed to cool, brushed lightly with oil and stored in the refrigerator.

Smoked Eel Fillets

The following process is for hot-smoking large eels from 3 to 6 feet in length and of up to 20 lb or more in weight.

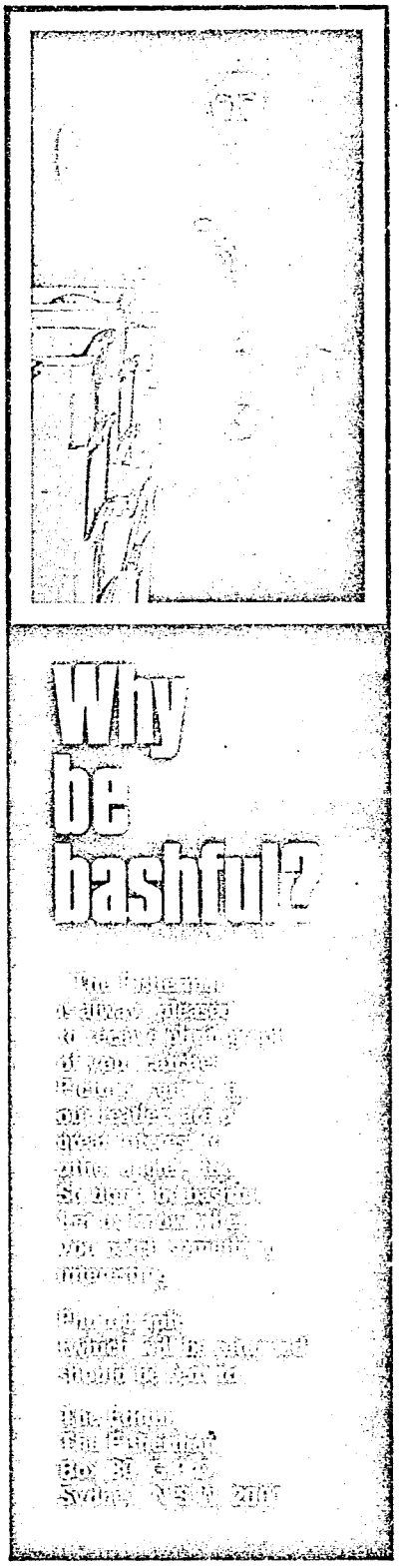
The eels are cleaned and gutted as described in the previous section, and are then filletted with the skin left on. The fillets are cut into sections 6 to 8 inches long and not more than 1 inch thick. A brine of 80 per cent is made and the fillets soaked in it for 30 minutes, removed and dried for 1 hour.

They are then put in the smokehouse on trays and smoked for 12 hours, with the heater on for the last 2½ hours. If there is a fan in the smokehouse the fillets should be ready after 5 hours; again, the last 2½ hours with the heater on.

They are then brushed lightly with vegetable oil and stored.

Smoked Mullet Roe

The roe should be firm and full, but not too ripe, and care should be taken not to rupture the skins. After washing in freshwater and



removing the blood clots, the roe are brined or dry salted. If brining is preferred, a 30-minute dip in an 80 per cent solution with an addition of molasses, in the proportion of 1:8 molasses of brine, should give a piquant taste and a healthy colour.

If dry salting is preferred, and among its benefits is a firmer product, a mixture similar to the one used for trout, but without the cloves, gives a rich experience to the connoisseur.

The roe is placed in layers of the mixture for 3 hours, and then thoroughly washed in freshwater. It will probably have lost about 10 per cent of its weight during this period. If the roe, after dry salting, looks wrinkled it is dipped for a minute in very hot water.

They are then left to dry for 30 minutes before being hung, or laid on trays, and put in the smokehouse. A cold smoke in a traditional kiln will take about 10 hours and there will be a further loss of about 20 per cent in weight. In a kiln with a fan, smoking will take between 4 and 6 hours.

The roe is now ready to eat.

Recipes for fish already smoked

This recipe is particularly good for cold-smoked fish.

2 cups of fish
2 cups milk
1 small onion diced
½ teaspoon mixed spice
2 tablespoons flour
2 tablespoons butter
3 medium diced cooked potatoes
Grated cheese

Poach fish; stir flour into milk and simmer to thick paste; add butter. Flake the fish into medium-sized pieces and put into greased baking dish in layers with potatoes. Pour milk and butter sauce over them, top with grated cheese. Bake in medium oven for 30 minutes.

Smoked Fish Pie (from cold smoked fish)

2 cups of fish
1 medium chopped onion
2 oz chopped celery
¼ lb butter
2 oz flour
2 cups of milk
1 medium chopped carrot
2 oz peas
2 hard-boiled eggs
Pinch of cayenne pepper

Steam the fish and flake it. Saute the celery and onion, blend in the flour and cayenne, stir in the milk and cook until thickened; add fish, carrots, peas and hard-boiled eggs, carefully stirring all the while. Put mixture into greased baking dish and cover with pie. Bake in hot oven: 450° F for 15 minutes.

Table 1

Brine strengths are tabulated as brineometer reading	Salt by weight		Qualities per imperial gallon
	Per cent	lb	oz
20	5·279	..	9
30	7·919	..	14
40	10·558	1	3
50	13.198	1	8
60	15·837	1	14
70	18·477	2	14
80	21·116	2	11
90	23·755	3	2
100	26·395	3	9

Table 2

BRINING BY SAL. READING

	Brining	Smoking time—Method	Weight loss
			Per cent
Mild Cure. Fish gutted (may be headed). Split down the backbone.	10 min 80 per cent salt brine	Mild: Cold 6 hours	10
Medium Cure. Fish gutted and prepared as above. Thick fish scored to give better brine and smoke penetration.	10 min 80 per cent brine	Smoke 10–14 hours	15–17

Table 3

Fish	Brine per cent by sal. reading	Smoking time hot with fan on	Weight loss
			Per cent
Mullet, gutted and split vertically along the cavity to the backbone.	10 mins 80 per cent	1 hour without heater + 2 hours with heater switched on.	20
Tailor, gutted and split as for mullet.	7–8 mins in 80 per cent brine.	1 hour without heater + 1¼–1¾ hours with heater.	18–20
Trout fillets*	Dry brine 2 hours	1½ hours without heater + 1½ hours with heater.	17–20
Hake fillets*	Dry brine 2 hours	1½ hours without heater + 1½ hours with heater.	18–21
Mullet fillets	5 mins 80 per cent	1 hour without heater + 1¼–1¾ hours with heater.	18–22
Commercially farmed trout weight approx. 12 oz, filleted.	2 mins 80 per cent	Smoked at 100° F for 80 minutes.	17–20

* Trout and hake are shown only as fillets because of the difficulty of hanging them in a hot smoke kiln without the flesh falling from the bones. The trays are prepared for the fillets by lightly painting them with oil, or else rubbed with dripping. This prevents the fat from the fish glueing the skin to the mesh. If it is decided to hot-smoke a whole fish, such as mullet or cowan-young, the results may be disappointing. The fish steams in its own jacket and although the taste will be pleasant the texture is soft and difficult to serve.

OF TROUT AND MEN

(*Continued from page 3*)

During the following year in Phillip Street (from ova received back from New Zealand) nearly 35,000 fry were raised for statewide distribution.

To obtain better hatchery facilities, State Fisheries, in 1890, opened a hatchery at the Prospect Reservoir near Sydney, with the assistance of the Metropolitan Water, Sewerage and Drainage Board.

In 1894, the first rainbow trout (*Salmo gairdneri*) eggs were received from New Zealand, this species originating from North America.

It should be stressed that the role played by acclimatization societies in the introduction of trout to New South Wales was an invaluable one. From their early involvement in hatchery operations, an involvement which lasted until the mid 1950's, and their constant efforts in the releasing of fry and fingerlings in suitable streams, the acclimatization societies were a major factor in the successful establishment of trout in this State. Today, trout acclimatization societies are still playing a vital role in the releasing of trout raised in N.S.W. State Fisheries hatcheries.

In 1957 legislation was passed for the formation of Inland Fisheries Fund, and with it the licensing of inland anglers. At this point the N.S.W. Government took over control of the hatcheries from acclimatization societies; probably at an opportune time, as operating costs and the manpower needed to run the hatcheries were beginning to be a drain on the limited resources of the purely voluntary acclimatization societies.

Today, two trout hatcheries serve the requirements of New South Wales: Gaden at Jindabyne, and

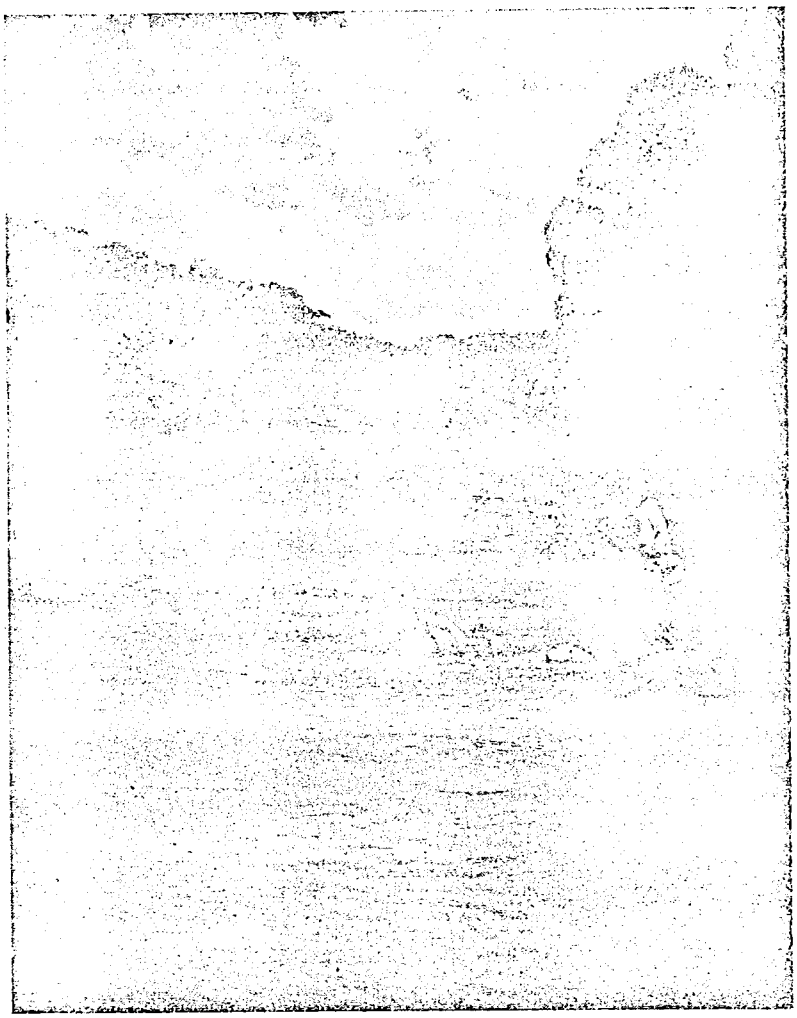
the L. P. Dutton Hatchery at Ebor, between Armidale and Dorrigo.

In earlier years the Gaden Hatchery played a vital role in the stocking of waterways in the Snowy Mountains/Monaro region but trout in the main lakes and their major tributaries are now maintaining their populations by natural breeding.

Nevertheless, Gaden today is still the rearing centre for the large quantities of trout needed for the restocking of suitable streams and waterways in southern New South Wales. The hatchery also acts as a base for a continuous programme of scientific research conducted by N.S.W. State Fisheries on fish and fisheries in the region.

Gaden Hatchery, on the Thredbo River, is about 4 miles from Jindabyne on the Kosciusko road and the turnoff to the left is indicated by a signboard. Guided tours start at 11 a.m. daily from near the visitors' car park at the hatchery.

The name Gaden Hatchery is in recognition of the many years of dedicated, voluntary work towards the advancement of trout fishing in the region by the late Mr J. Gaden. Mr Gaden was long associated with the Monaro Acclimatisation Society, and was the society's president for 14 years.



What can rival the beauty of an unspoiled trout stream in the Snowy Mountains?

(Photo by courtesy N.S.W. Dept. of Tourism)

Estuaries: Development and 'progress' versus commonsense

by Dr D. A. Pollard,
N.S.W. State Fisheries

When originally invited to give this talk, the title suggested was "Environmental Problems in the *Management* of New South Wales Estuaries". However, I have since substituted the word "protection" for "management", as in the past there has been too much "management" of our estuaries in the traditional sense of the word. Management implies the maximization of short-term economic gain, and too little in the broader sense, which I hope will become increasingly recognized, implying

An Outline of the History of FISH CURING* to the Year 1929

**Fish curing is taken here to mean drying, salting and smoking of fish, or any combination of these methods.*

by Patrick Parrish

Mr Parrish, a technical assistant with N.S.W. State Fisheries, has made a study of fish smoking. In this article he presents an outline of its history up until 1929. A second article, to be published in a forthcoming edition, deals with modern developments.

Early man was a hunter. Apart from momentary diversions to ensure the continuance of the species, all his powers of concentration were bent on a hunt for food. His endless searches among the fruits and berries along the river banks in autumn, and for fish, trapped in the shallows after summer drought, saw the beginnings of his first settlements. Fish was man's most constant and accessible source of protein. He watched it with an invincible appetite.

DR DAVID POLLARD was appointed environmental studies biologist in 1971. He is presently undertaking a programme of ecological studies aimed at evaluating the possible effects of a proposed nuclear power station on the marine environment and fisheries resources of Jervis Bay.

Dr Pollard, who was born in Sydney, graduated with a Bachelor of Science (honours in zoology) degree from the University of Sydney in 1962. Later he obtained the degree of Doctor of Philosophy from the Department of Zoology and Comparative Physiology, Monash University, Victoria.

Since then he has held a post-doctoral fellowship at the Institut des Peches Maritimes, at Sete, on the Mediterranean coast of France, worked as a visiting scientist at the British Museum (Natural History), London, and travelled extensively in Europe, North Africa and Asia.

His research has been concentrated mainly on the ecology and evolutionary systematics of both freshwater and marine fish, and his current interests centre around the community ecology of fish and conservation of the aquatic environment and its resources, including the biological effects of pollution and the ecology of artificial reefs.

His interests include SCUBA diving, underwater photography, sailing and fishing.

MR LELAND WYSE has been appointed fishbreeding biologist at the Inland Fisheries Research Station, Narrandera.

One of the new projects currently being undertaken at the station is the breeding (for sale) of young fish for the stocking of farm dams.

Mr Wyse will be responsible for this work.

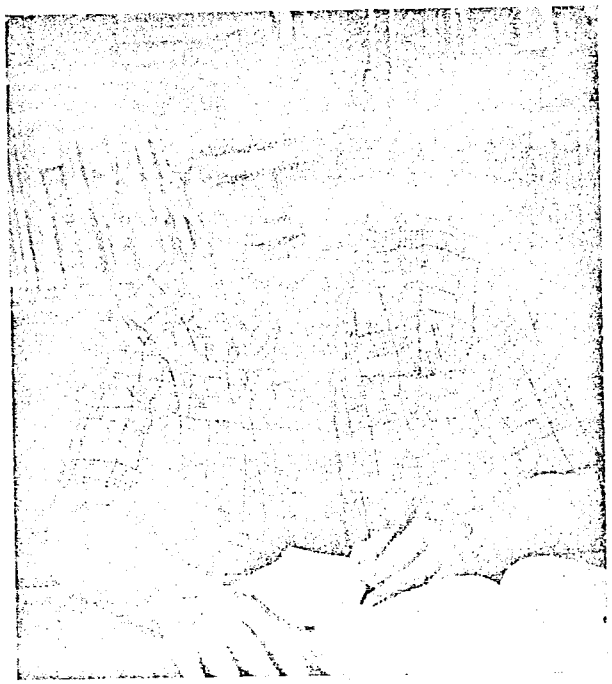
He was born in Wayland, Iowa, in 1940 and was educated at Ohio.

After leaving school he served overseas for several years with the U.S. Army. Following discharge, he undertook further studies and graduated in 1970 from Oregon State University, Corvallis, with a science degree in Fisheries and Wildlife.

He has been considerably interested in fishbreeding for some years and his experience in this field will be of great help to him during his work at Narrandera.

Dr D. A. Pollard

Mr L. C. Wyse



Where it had been stranded and dried by the sun he saw the feral cats savage for it, and the qualities which make a successful hunter—careful observation, precise memory and the inductive intelligence which seeks the cause behind the effect—were now used in the founding of the science of food preservation.

During periods of glut, fish were hung to dry in the sun and then furtively hidden away, against the lean times ever running at the hunter's heels.

It is no accident that the earliest civilizations were by the banks of rivers in semi-tropical climates. To those early men the river was sacred.

As the food supply became more stable, population pressures grew. So the hunt began again.

New rivers with new fish were man's new frontiers. In the higher latitudes the fishing was good, and when winter came and the rivers froze, man remembered the hot summers of his youth, and dried his catch over the fire in his cave.

He acquired a new taste, as well as a new process, for soot and smoke deposits made for a harsh piquancy, different to the bland tastelessness of the sun-dried product.

Recent diggings in the Dordognes of France produced evidence, dating back to around 40,000 B.C., which showed that cured marine fish had been a major part of the diet, as did later evidence, circa Bronze Age, from England and Ireland.

The caves of the Dordognes, 100 miles inland, are scattered with bones of sea-fish and the areas unearthed around Sheffield, 70 miles inland, were salted with the bones of herring and cod. In Ireland, by the banks of the Bann, the bones of salmon, thick by mounds of wood ash, indicate that the art of smoking was established there long before the ancient Druids got around to smoking the early Christians.

"It is not sufficiently realized that invention of these methods (curing) was a major achievement, deserving to rank in importance for the future of mankind with the invention of the wheel, and has certainly had a far greater effect on man's existence hitherto than many more spectacular inventions, for example the aeroplane or atomic power."

Dr G. H. O. Burgess
Director
Torry Research Station

It is not so easy to date back to the advent of salt into the curing process. Evidence has ebbed away. But the deltas of the great rivers are well-situated for the formation of solar salt deposits, and it is possible that after observing the condition of the fish, stranded in the salt pans, man was led to experiment.

Certainly, the very earliest of recorded history on the midwaters of the Nile shows that salt, as well as the river, was already invested with religious significance. Associations of priests, known as "The Brotherhood of Picklers", officiated on special fish eating days, and the later Ptolomies, as well as making human sacrifice to the river, explored a vein of avarice by taking out a complete monopoly on salt!

The Minoan civilization, some 1,500 years after the first of the Egyptian civilizations, was probably the first to base its economy on marine fish. And it seems likely, from the records of the succeeding Archean and Phoenician Empires, that salt was the principle preservation. Towns named Sidon, the fishers' town, and Malaga, the salting place, were major goals for overseas voyages.

But it is not until the Hellenic civilization, when man began to detail all of his activities, from metaphysics to economics, that the full importance of fish as the anchor in the economic storms which must beset any civilization based on primary industry, is dramatically clear. And the greatest part of that fish had to be cured.

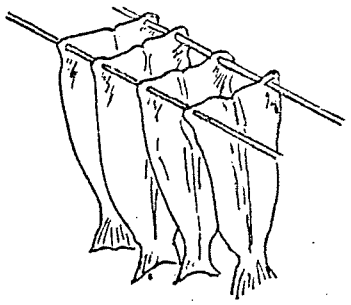
Salted, dried and occasionally smoked, "tarichos" appears to have been basic to the diet of the Greeks and as tedious as porridge to the Scots.

And through history there is a continuous background chorus of lament from troops in battle, particularly the Spartans, about dry and salty rations.

By the time of the Roman Empire takeover, fish curing was no longer

just a means of personal sustenance, but a very big business.

Pliny, in the first century A.D., writes of a merchant in Syracuse building a ship with special provision to take 10,000 barrels of cured fish. Alexandria is thought to have been the only port big enough to take it.



The demands on the curers became not only extensive, but exotic. Most people were content with a supply of salted tuna and mackerel, but salted blood and entrails were compressed in large jars and sold to sophisticates, at high prices, as "garum". The same ingredients were sometimes sealed in jars and allowed to decompose by autolysis and were then also considered a delicacy.

Little is known about the development of fish curing from the time of the fall of the Roman Empire until the period when the Danes made their attacks on the Caroligian Empire.

The monks in Ireland went on preserving salmon, but the smoke from the pillaging and burning of the Dark Ages did little to preserve the details of history.

But one of the unforeseen sidelights of the Danish raids was the discovery of new fishing grounds in the North Sea.

For the next 1,000 years the significance of those grounds cannot be over emphasized.

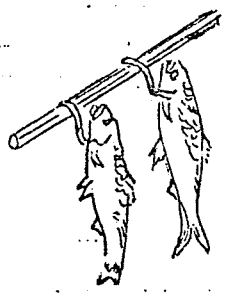
It is as well to remember that until the development, by Townly, in the 18th century, of a turnip which would keep throughout the winter for stockfeed, most grazing animals had to be slaughtered at the beginning of winter, and that fish, as in the very early days, was still man's most constant form of protein.

In the clangour of wars and the sweep of man's more barbarous ambitions, the fishing industry had gone largely unheralded, like a blood transfusion at a riot.

The discovery of the new fishing grounds in the North Sea precipitated the transfer of the centre of fish curing activities from the Mediterranean to north Europe, and an industry, employing millions of people, was strung around the coast from Spitzbergen to Brest.

By the 13th century the Dutch and the Hanseatic League were using cured herring as currency.

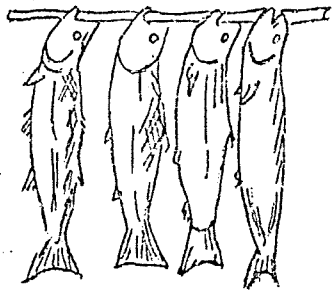
Such was the steady growth of the industry that four centuries later, over one-fifth of the total population of Holland was employed either in catching or processing fish.



Variations were introduced: Norway and Sweden inclined to a wind dried fish, "stockfish", which is still important in the industry today. Holland and the eastern European countries were hooked on salt-curing. Britain on smoke.

Some variations on a theme were dictated by the species of fish. Herring and other fat fish were packed tight in pickle, to prevent oxidation, while haddock and "white fish" were given a hard, dry salting, followed by weeks of thick smoking. The resultant product must have been a mighty tough one.

As the industry flourished, regulations were introduced. Fish was classified as to size and condition, i.e., "full" or "spent". Size of nets and mesh sizes allowed



were specified, as were seasons and methods of packing and branding. The sizes of boxes and barrels were also specified. Salting down small fish in a barrel marked for large ones could get a man into a lot of trouble.

In 1620, the College of Fisheries was founded at Delft, Holland. In his work, "Smoking"[1], C. L. Cutting lists some of the statutes it enforced:

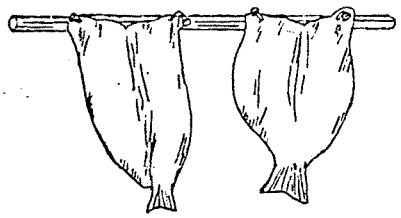
"No one may pack poor quality herring with good herring, but the former may be packed separately and labelled "nachtshamel" (overdays). No one to lay fish crossways and so give poor weight for measure, or put the old under the new, or lay those bitten by dogfish with sound fish, or pack those fish caught on one night with those of another night's taking. No fish to be heightened with fresh pickle, nor packed but in the public street, or on the quays, or in customary places with opened door to facilitate inspection."

	Description	Salting	Smoking
Bloaters	Herring, whole, ungutted	Dry salt in vats. 1 : 2 salt to fish overnight.	Cold smoke 12 hours. Some heat from wood.
Buckling	Herring, whole, ungutted	Dry salt overnight	Hot smoked in dense smoke four hours.
Kippers	Herring split down spine. Gills and guts removed.	Brined 30 minutes in a 70 per cent solution.	Cold smoked over sawdust fires 10 to 18 hours.
Reds	Herring, whole, ungutted	Dry salted in barrels 7–8 salt to two fish by weight.	Cold smoke alternate night and day for 1 week.
Finnans	Haddock, Codling, headed, gutted split. Extra cut in larger fish.	15 minutes brine in 70 per cent solution.	Cold smoke 6–12 hours.

Some of the cures listed in the table, kippers, for example, did not get their precise designation until the mid 19th century.

Although the early part of the 16th century was the time of Dutch ascendancy in the fish curing industry, and salting was the most prominent of their methods, other highly esteemed procedures were becoming accepted:

Curers sought to distinguish their products by various approaches. For example, by using different kinds of woods for the smoking, different herbs, weeds and incantations etc., for the pickle.



At different times of the year, various sorts of salt were used for the brine. Portuguese and Spanish salt were used until the feast of St James. Fish thus treated was known as the fish of the large salt. Fish cured after St James' feast was called the Dutch, or fish of the fine salt.

But some curers went too far in their search for novelty. For instance, one patent taken out, aimed to preserve fish by smoking it in chilled hydrochloric acid and then neutralizing the taste and odour of the acid by washing the fish in a bath of chlorine of calcium.

If that idea makes you twitch, how about this one? A Dutch curer tried to short circuit the whole fish curing process by soaking fish for 1 hour in a mixture of urine and tobacco juice!

Industrial Revolution

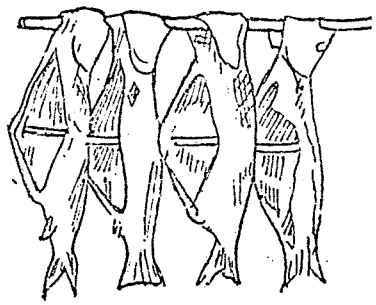
The 18th century saw the beginning of the Industrial Revolution, with its urban proliferation and comparitively fast travel.

Mechanical man was full of ambition and among his many new endeavours was an attempt to mechanise the fish curing industry.

Vast tunnels, with steam-driven fans, were built to speed drying, and Burgess[2] talks of an enormous contraption, designed for smoking, with dimensions of 70 ft x 70 ft. Burgess doubts if it was ever actually built, but plans for it give some idea of the scope of the ambition of the times.

But it was ambition which was, metaphorically, blinded by its own smoke, for while the pressing need for food remained, people were becoming more and more discerning. Flavours which had been acceptable for so long were gradually beginning to be considered as "violent assaults".

For the curing industry, the railway carriage was a hearse. Fresh fish, and other fresh products, were being transported rapidly to industrial areas inland. Tastes



rapidly changed as a result. The toll was ringing and the advent of canning and refrigeration became the brass handles on the coffin.

But the people in the industry were too occupied to notice, for until the World War I, demand

appeared to be growing. There was a considerable export market. Britain alone exported around 550,000 tons of cured herring a year, mainly to eastern Europe. Sweden and Norway were also busy with exports. However, Holland's industry had generally slipped back.

With the war came a greatly increased number of industries concerned with the preservation of food—by other methods than curing.

From 1919 the demand for cured fish dropped alarmingly. Those involved in the industry recognized, at last, that something would have to be done.

The setting up of the Torry Research Station, in 1929, saw the beginning of a comprehensive scientific study into fish curing. The aim of the research was to find ways of producing a mild-tasting, uniform product which would win the regard of the masses.

More about all that in a forthcoming article, but it is worth mentioning now that there were some reactionaries in the industry, and even today, traditionalists in north-western and eastern Europe are holding out against what they see as attempts to reduce the taste experience to the level of zero.

For my own part, when I buy smoked fish in the clinical atmosphere of the supermarket, I catch across the ages the laugh of the man crouched by the river, and glimpse the mordant smile of his brother, blinking by a fire in his smoke-filled cave.

[1] *CUTTING, C. L.:* "*Smoking*", *Vol. III,* Fish as Food. *Academic Press,* 1962.

[2] *BURGESS, G. H. O.:* "*Developments in Handling and Processing Fish*", Fishing News (*Books*) *Ltd,* 1965.

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