FISHERIES DEPARTMENT, WESTERN AUSTRALIA

MONTHLY SERVICE BULLETIN

Vol. IV, No. 8. August 1, 1955

STAFF NOTES

The Superintendent (Mr. A.J. Fraser), the Clerk-in-Charge (Mr. B.R. Saville) and Technical Officer J.S. Simpson, attended the annual general meeting of the Pemberton-Warren Trout Acclimatisation Society on Thursday, July 21, at Pemberton. Later, on Saturday, July 23, they were present at a meeting of the Murray Trout Acclimatisation Society at Dwellingup.

The Superintendent intends to leave Perth on Saturday, August 13, to join the research vessel "Lancelin" for a week's survey of the Abrolhos fishing areas.

Mr. B.R. Saville and Technical Officer J.S. Simpson will leave Perth on August 15 for discussions on the propagation of trout at Tambellup, Ongerup, Gnowangerup and elsewhere.

The Supervising Inspector (Mr. J.E. Bramley) visited the Albany fisheries district last month from July 26 - 29. He inspected the Cheynes Beach Company's whaling station at Albany and called in at Denmark and Parry's Inlet on general matters.

Inspector G. Coombes and Assistant Inspector G.H. Lyon will bring the p.v. "Kooruldhoo" to Fremantle for re-fit after completing an excellent job at the Abrolhos. The p.v. "Leschenault" will remain in Geraldton under the control of the district inspector.

Inspector H.J. Murray was transferred to Perth as from July 22.

Inspector S.W. Bowler will leave Geraldton on August 5. He will take over the Mandurah district permanently on August 8.

Five officers will commence annual leave in August. Cadet Inspector M.J. Simpson will start on August 8. During his absence Assistant Inspector R.J. Baird will take his place at Mandurah. Inspector A.J. Bateman will commence leave on August 15, as will Mr. I. Bartholomew of Head Office. Relieving Inspector A.K. Melsom's leave will begin on August 22, and that of the Supervising Inspector (Mr. J.E. Bramley) on August 28.

Advice has been received that Cadet Inspector L.W. Duncan, who has been assisting at the Pemberton trout hatcheries, will enter hospital this month for an operation. Cadet Inspector D. Wright will assist at Pemberton during Mr. Duncan's enforced absence.

Mr. B.K. Bowen of Head Office will visit the hatcheries at Pemberton with Technical Officer J.S. Simpson during the month for a survey of trout acclimatisation activities.

Miss Faye Higgins resigned from the Department on July 15 to enter the Commonwealth service. Her duties at Head Office have been taken over by Miss Jacqueline Harvey, who commenced on July 25.

Technical Officer L.G. Smith has completed his July assignments under the estuarine research programme. Samples taken from May to the middle of July were forwarded to Cronulla for examination on July 27. During August Mr. Smith will carry on the usual programme at Albany, Denmark, Bunbury and Mandurah.

The Senior Clerk (Mr. H.B. Shugg) and the Fauna Warden (Mr. G.C. Jeffery) returned from a survey of fauna on the Abrolhos on July 22. A brief report on their observations appears elsewhere in this issue.

Inspector G.C. Jeffery will leave early in August for an inspection in the Busselton-Augusta area, principally in connection with duck breeding grounds around Busselton.

PERSONAL PARS

Dr. G.L. Kesteven, Chief Biologist of the Fisheries Division of FAO, Rome, together with his wife and family, passed through Fremantle on July 31 en route to Sydney on leave. The opportunity was taken by the Superintendent to invite a number of local people interested in fisheries to meet Dr. and Mrs. Kesteven at an informal party at his home. Those present included Professor H. Waring (Professor of Zoology, University of W.A.) and Mrs. Waring; Dr. E.P. Hodgkin (Reader in Zoology) and Mrs. Hodgkin; Dr. K. Sheard and Messrs R.G. Chittleborough and R.W. George, of the C.S.I.R.O. Division of Fisheries, and their wives; and Messrs B.R. Saville and B.K. Bowen, of this Department, who were accompanied by Mrs. Saville and Mrs. Bowen.

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Mr. R.G. Chittleborough, of the Division of Fisheries, C.S.I.R.O., Perth, has received advice to the effect that he has satisfied the requirements of the Faculty of Science for the degree of Doctor of Philosophy of the University of Western Australia. To Mr. Chittleborough, who has done some first-class work on the humpback whales on this coast, we extend heartiest congratulations.

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A visitor to Perth during July was Dr. W.A. Westerman, Assistant Secretary of the Department of Commerce and Agriculture, Canberra. Dr. Westerman discussed with the Superintendent several matters of interest to both this Department and the Fisheries Division of his Department (the Commonwealth Fisheries Office).

NEW PATROL VESSEL

Plans for a new vessel are now being drawn up by an officer of the Fremantle Harbour Trust. They will be a modification of the wartime Army work-boat.

Pending its construction, it has been decided to repair the p.v. "Garbo" at Geraldton and

use her until such time as the new boat is completed.

PEARLING

Advice has been received from Pearling Inspector M. Goodlad that the last of the Japanese specialists reached Broome on July 6. His arrival completed the quota of Japanese and Ryukuan whose entry was permitted by the Commonwealth Government to allow a full complement on the luggers at present operating.

Mr. Goodlad has also advised that the Australian Workers' Union has refused to handle shell fished by Japanese. According to a press report, it is not known what action the owners of the banned shell will take. They may arrange to have it overlanded from Broome and shipped overseas by vessels of the Blue Funnel Line, which appear to be handling all pearlshell consignments. Eighteen cases of pearlshell have been loaded at Onslow on the "Kabbarli" en route to Fremantle. This particular shipment, it appears, was not subject to the Union's ban, as the shell was obtained by Malay divers.

The Pearling Inspector at Onslow, Mr. A.H. Clark, advises that there was a slight increase in pearling activities in Onslow during June. Mr. Neil Clark has been able to commission a second lugger following the arrival of his complement of Japanese divers. Mr. Lloyd Jones has left the crayfishing industry for the winter months, and is engaged in pearling in the area. A Broome boat owned by Mr. Morgan is also working there. The owners of the fishing boat "Villaret" have displayed an interest in pearling at Onslow, and it is understood that the vessel, which has already paid one visit, will be returning there later to commence pearling operations, probably by means of aqua lung equipment. Mr. Clark comments that the Japanese divers and tenders are showing a great deal more enthusiasm for their work than has been displayed by other crews during the past few years.

WHALE MORTALITY

Early last month a letter was received from Mr. M.R. Edwards, of Manjimup, that he had sighted a large number of dead whales on the beach near Black Point, half-way between the mouths of the Donnelly and the Blackwood Rivers.

Inspector J.L. Gallop was detailed to inspect the whales, and if possible to secure the skull of the smallest fish for identification. Mr. Gallop left Bunbury on July 15, and after obtaining directions started off on the long journey to the south coast. The track was particularly bad, and at one stage it took him three hours to drive 17 miles through swampy country where at times the water was well over the running board. He had to leave his vehicle eight miles from the beach and complete the journey on foot. He was able to locate only one of the whales, as darkness was rapidly approaching.

He took a count of the mammal's teeth and found that it contained 20 in the lower jaw and 6 in the upper. Its total length approximated 25 ft. Although Mr. Gallop extracted some teeth from the top jaw and with them forwarded a sketch of the tail, the species has not yet been identified. Owing to the almost impassable nature of the track, it was out of the question to attempt to secure any part of the whale for transport to Perth.

FAUNA PROTECTION ADVISORY COMMITTEE

It has been announced that the Lieutenant-Governor in Executive Council has re-appointed the following members to the Fauna Protection Advisory Committee for a term of three years from July 1, 1955:-

Dr. D.L. Serventy, Principal Research Officer, Wildlife Survey Section, C.S.I.R.O.;
Mr. L. Glauert, Director of the Perth Museum, and
Mr. J.B. Higham, of Albany.

The Minister has appointed the undermentioned persons as deputies to members of the Committee:-

Mr. B.R. Saville, deputy to the Chief Warden of Fauna (Mr. A.J. Fraser);
Mr. J.S. Crawford, deputy to the Chief Vermin Control Officer (Mr. A.R. Tomlinson);
Mr. A.J. Milesi, deputy to The Conservator of Forests (Mr. A.C. Harris);
Dr. G.M. Dunnet, deputy to Dr. D.L. Serventy;
Mr. A.M. Douglas, deputy to Mr. L. Glauert, and
Mr. Angus Robinson, deputy to Mr. J.B. Higham.

FISHERMEN'S ADVISORY COMMITTEE

It was notified in the "Government Gazette" of June 24 that the Minister for Fisheries had reconstituted the Fishermen's Advisory Committee. The Superintendent (Mr. A.J. Fraser) is chairman, ex officio, and Mr. H.B. Shugg is secretary. Each of the following persons has been appointed a member of the Committee for the term shown opposite his name :-

Name	Term of Office
Mr. N.K. Swarbrick, Albany	: June 1, 1955, to Nov. 30, 1956
Mr. F. Camarda, Fremantle	: June 1, 1955, to Aug. 31, 1957
Mr. W. Matthei, Yunderup	: June 1, 1955, to May 31, 1958
Mr. Roland Smith, Perth	: June 1, 1955, to May 31, 1958

INTERSTATE FISHERMEN LOOK AT W.A.

Inspector S.W. Bowler reports that last month he was visited by Messrs G. Brown, J. McDonald and W. Rodgers, professional fishermen of Lorne, Victoria, who called on him to make enquiries into prospects of the fishing industry in the Geraldton area. Before leaving they expressed a firm intention to return and commence both crayfishing and fishing. Mr. G. Brown is the president of the Lorne Fishermen's Association.

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Mr. H. Wilson, professional fisherman of Port Lincoln, South Australia, visited Perth during July. He operates the 66 ft. vessel "Mars", and is engaged in both crayfishing and sharkfishing. Mr. Wilson, who until

recently was a member of the Board of the South Australian Fishermen's Co-op Ltd., pioneered the use of echo-sounders in S.A. for the location of crays and sharks.

MORE FISHING BOATS IN TROUBLE

The 50 ft. auxiliary ketch "Queen" owned by the Golden Gleam Processing Co. Ltd., of Geraldton, was wrecked on a reef midway between Carnarvon and Shark Bay on July 20. The skipper of the vessel, Charles Lonva, and his crew of two, were forced to swim ashore through heavy surf. They were observed by the fishing vessel "Proton", which rescued the castaways from the beach and transferred them to this Department's research vessel "Lancelin", which later took them to Denham. When last seen the vessel was breaking up on a reef near Dorre Island. The "Queen" had been bound for Geraldton with a full load of snapper estimated to weigh between 7,000 and 9,000 lb. She had seen long service as a crayfish carrier on the run between Geraldton and the Abrolhos, and as a snapper boat in the Shark Bay area.

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Fisherman Clement Moss, skipper of the 40 ft. cray boat "Estra", walked 25 miles for help after swimming ashore when his vessel was swamped by a freak wave off Jurien Bay on July 26. It seems "Estra" was making for shelter in a choppy sea when a huge wave hit her when about two miles from the entrance. Mr. Moss and his three crew members were thrown into the sea, and then another freak wave righted the boat, which has since been towed into Fremantle. The wheelhouse and mast were badly damaged and the engine was waterlogged. No damage was suffered by the hull.

UNIVERSITY OF W.A. MEDICAL SCHOOL APPEAL

The approval of the Public Service Commissioner and the Under Treasurer has been granted for officers to give official assistance to the conduct

of this appeal. One officer from each Department has been nominated to act as an agent for the Appeal Committee to distribute procuration orders. Any member of the staff of this Department may, if he so desires, complete a procuration order for a certain sum to be deducted from his pay each fortnight to be credited to the Appeal Fund. All donations are permissible deductions as "Gifts" on income tax returns, and donors will either be given a receipt from the Department for the total contributions after the procuration order has expired, or the total amount may be shown on the employee's group certificate. Outright donations can, of course, be made direct to the directors of the fund.

Mr. H.B. Shugg, of Head Office, has been nominated as this Department's agent for the Committee, and will distribute procuration orders, when they are available, as and when desired.

FAUNA AT HOUTMAN'S ABROLHOS

With Inspector G. Coombes and Assistant Inspector G.H. Lyon, Mr. H.B. Shugg and Inspector G.C. Jeffery spent over a week on the p.v. "Koorul-dhoo" at the Abrolhos last month.

Leaving Geraldton on July 13, the visitors were taken to Pelsart Island in the Southern Group, and then north through the Easter and Wallabi Groups to North Island. On the return trip a day was spent at the Easter Group before returning to Geraldton on July 21.

Birds observed included pied and sooty oyster-catchers; pacific and silver gulls; welcome swallows; fairy, crested, roseate and caspian terns; brown and curlew sandpipers; silvereyes; ospreys; pied cormorants; white-breasted sea eagles; wedge-tailed shearwaters; bosun birds; white-faced storm petrels; painted quail; brush bronzewings; spotted scrub wrens; black-fronted dotterels and one heron - probably a reef heron. On West Pigeon Island in the Wallabi group, an immature and a recently hatched silver gull were found, giving evidence of the winter-nesting of this species.

At East and West Wallabis many tammar were seen. These little wallabies appeared to be in very good condition and were fairly tame, suggesting that there has been very little, if any, interference with them. As these tammar are an insular sub-species, it is most important that they should be left undisturbed for scientific study.

Three different varieties of lizards, and a carpet snake over six feet long, were also seen on West Wallabi.

ABNORMAL FISH MORTALITY IN SWAN RIVER BASIN IN APRIL, 1955

by Athol Middleton, B.Sc.*

(1) Introduction

During April 1955 three separate outbreaks of fish mortality in the upper reaches of the Swan River were reported. The Hydrology Section of C.S.I.R.O. Division of Fisheries, Perth, was requested to investigate and, if possible, determine the cause of these phenomena.

The results of the investigation yielded fairly strong support to the hypothesis that these fish died of oxygen deficiency due to their environment becoming contaminated with oxygen-deficient water, this oxygen-deficient water being derived from the deeper parts of the basin by "upwelling", which was most likely caused by tidal pressure.

The areas affected and dates of investigation were as follows -

(1). Bull Creek (Canning River), mainly on the western side - April 1, 1955.

(2) Perth Water, from the Royal Flying Squadron to the Mill Street drain, with particular concentration in the vicinity of the P.W.D. Harbours and Rivers Jetty - April 8, 1955.

(3) Como Beach at the foot of Thelma Street - April 21, 1955.

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* An officer of the hydrological section, Division of Fisheries, C.S.I.R.O.

The fish which suffered were the same in the three cases, and consisted of such species as Flathead (Platycephalus), Whiting (Sillago), Flounder (Pseudorhombus), Goby (Glossogobius), Trumpeter (Helotes) and Cobbler (Cnidoglanis), which are mostly bottom feeding types.

Fish which were seen in difficulties in the affected areas were floating or swimming feebly head uppermost near the surface, and were constantly gulping with the gills wide open. The fish were apparently uninjured, but the gill surfaces were quite purple in colour.

An examination of specimens by a pathologist of the Animal Health and Nutrition Laboratories, and by Dr. K. Sheard of the C.S.I.R.O. Division of Fisheries, showed no discernible diseased condition or harmful organism.

Unfortunately in the cases of Bull Creek and Como Beach the hydrological investigations were, of necessity, made after the fish had died and only in the case of Perth Water were samples collected while fish were dying. Hence the following argument can be applied with a reasonable degree of certainty only to the Perth Water phenomenon. There is, however, evidence to suggest that all three occurrences were caused by similar circumstances. That is, they all occurred either immediately prior to, or during, periods of unsettled weather conditions; in other words, at times when considerable barometric changes were occurring, and as will be shown later, the barometric conditions markedly affect the tidal behaviour of the river.

(2) Hydrological Conditions

In order to be able to understand the suggested cause of the mortalities, some elementary knowledge of the hydrological conditions obtaining in the "basin" during a typical winter period is necessary. We define the term "basin" as that part of the river lying between the Narrows and the Fremantle Traffic Bridge.

After the onset of the winter rains, usually about the middle of June, a freshwater discharge

commences to flow down the Swan-Avon River system. This discharge-water is usually appreciably cooler and contains much less salt than the marine water which is occupying the basin at this time. It is therefore less dense than the basin water, and it forms a layer over the surface when it reaches the basin. The depth of this freshwater layer is dependent on the severity of the runoff, being deepest when the runoff is most intense.

The contour of the basin is such that it is shallower at either end than in the middle, and consequently when the freshwater layer reaches a certain critical depth it effectively isolates the deeper basin waters from the sea. When thus isolated, the circulation in the deeper waters is impeded and they become stagnant. Their oxygen content steadily decreases, and the phosphate and nitrate content increases until, if the stagnation period is sufficiently prolonged, the oxygen content of the isolated basin waters may reach zero. In other words, there may come a time when certain volumes of basin water contain no dissolved oxygen at all and are consequently uninhabitable by aerobic organisms, i.e., organisms which need oxygen for their growth.

As the intensity of the runoff diminishes, the thickness of the surface freshwater layer also decreases until it no longer isolates the basin from the sea. At this stage dominantly marine water spills over the sill at the seaward end and penetrates the estuary along the bottom. This marine element can be identified by its high oxygen and low phosphate and nitrate content.

In the deeper waters at the seaward end of the basin this spillover is apparently quite energetic, and it mixes quite considerably with the stagnant basin waters. However, as it starts to creep up the slope* towards the upstream end of the estuary the mixing occurs to a lesser extent and pockets of the stagnant water may remain in the vicinity of Applecross for some considerable time.

Apart from the continual and constant penetration of marine water along the bottom, the whole of

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* Vide note on pp. 122 - 124 of July, 1955, Bulletin.

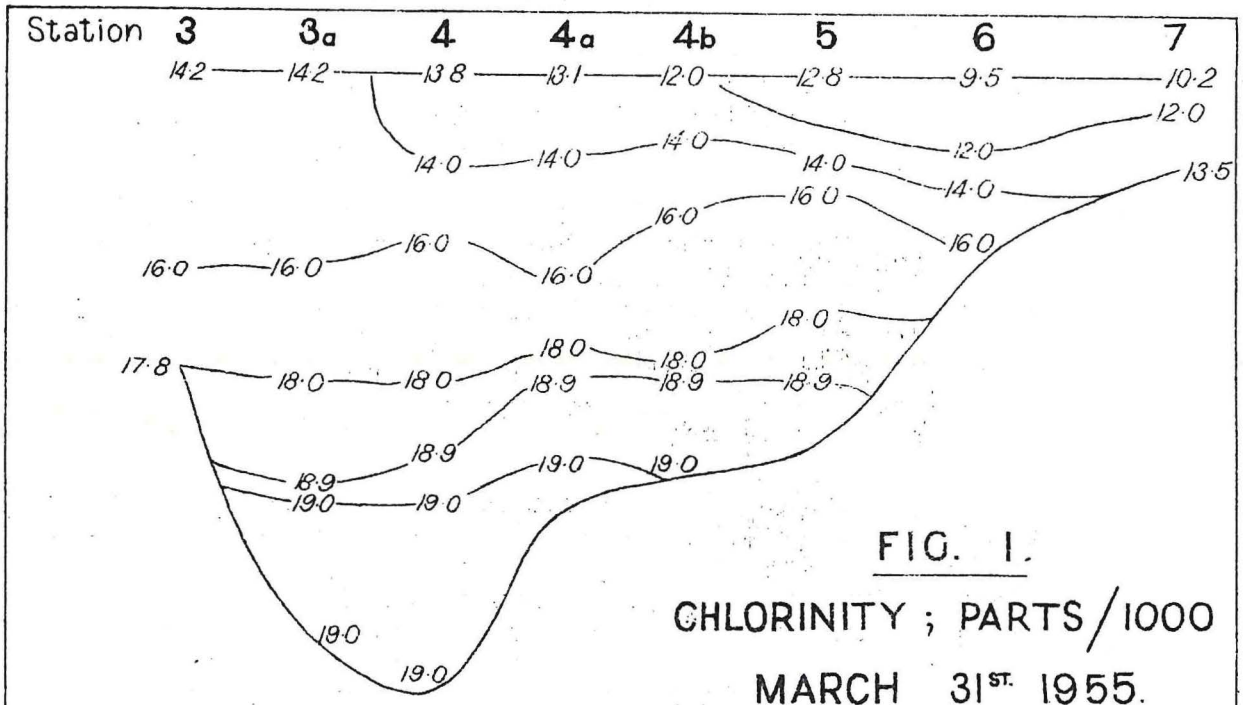
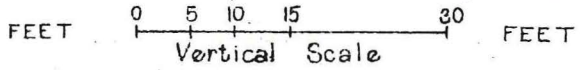


FIG. 1.

CHLORINITY ; PARTS/1000

MARCH 31ST. 1955.



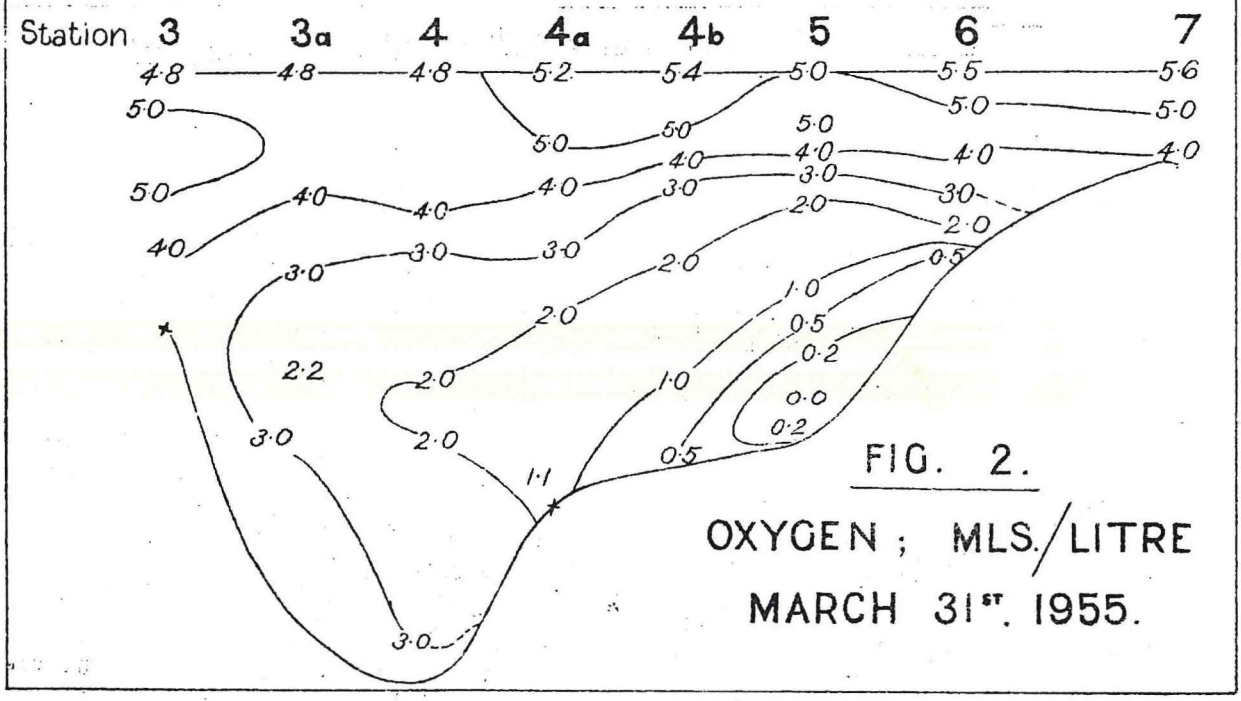


FIG. 2.

OXYGEN ; MLS./LITRE

MARCH 31ST. 1955.

the basin waters oscillate back and forth under the influence of tidal pressure. This tidal pressure under conditions of high tide will tend to force the stagnant waters farther upstream, and since the basin becomes progressively shallower they will be compelled to occupy a position at some lesser depth than their normal. That is, the stagnant or oxygen-deficient waters are forced nearer the surface in the upper reaches as the tide rises, and vice versa.

This is a highly simplified picture of the conditions obtaining in the estuary under stratified or winter conditions, but will be sufficient to illustrate the point in question.

(3) February Flood Conditions

The cyclonic depression centred off Onslow during the week beginning February 14, 1955, caused very considerable general rainfall over the southern half of the State, and resulted in a most unseasonable and intensive freshwater discharge down the Swan-Avon River system. This discharge in terms of winter flooding was of short duration, but was of sufficient length to set up a typically winter condition of stratification in the estuary.

Figures 1 and 2 show the chlorinity and oxygen distribution in the basin on March 31, 1955. From Figure 2 it can be seen that the oxygen tension is zero at a depth of approximately 35 feet at Station 5, and that until we go downstream as far as Station 3a all the water below a depth of approximately 12 feet has an oxygen tension of 3 millilitres per litre or less. An oxygen tension of 3 ml./litre represents the lower limit for the comfortable existence of most fish.

From Figure 1 it can be seen that water of chlorinity 19.0 parts per 1000 has penetrated along the bottom as far as Station 4b, and that there is no water of chlorinity 14.0 parts per 1000 above a depth of 13 feet at Station 6.

Figures 3 and 4 show the chlorinity and oxygen distribution in the basin on April 5, 1955. From Figure 4 it can be seen that the volume of water with oxygen tension below 3.0 mls/litre had

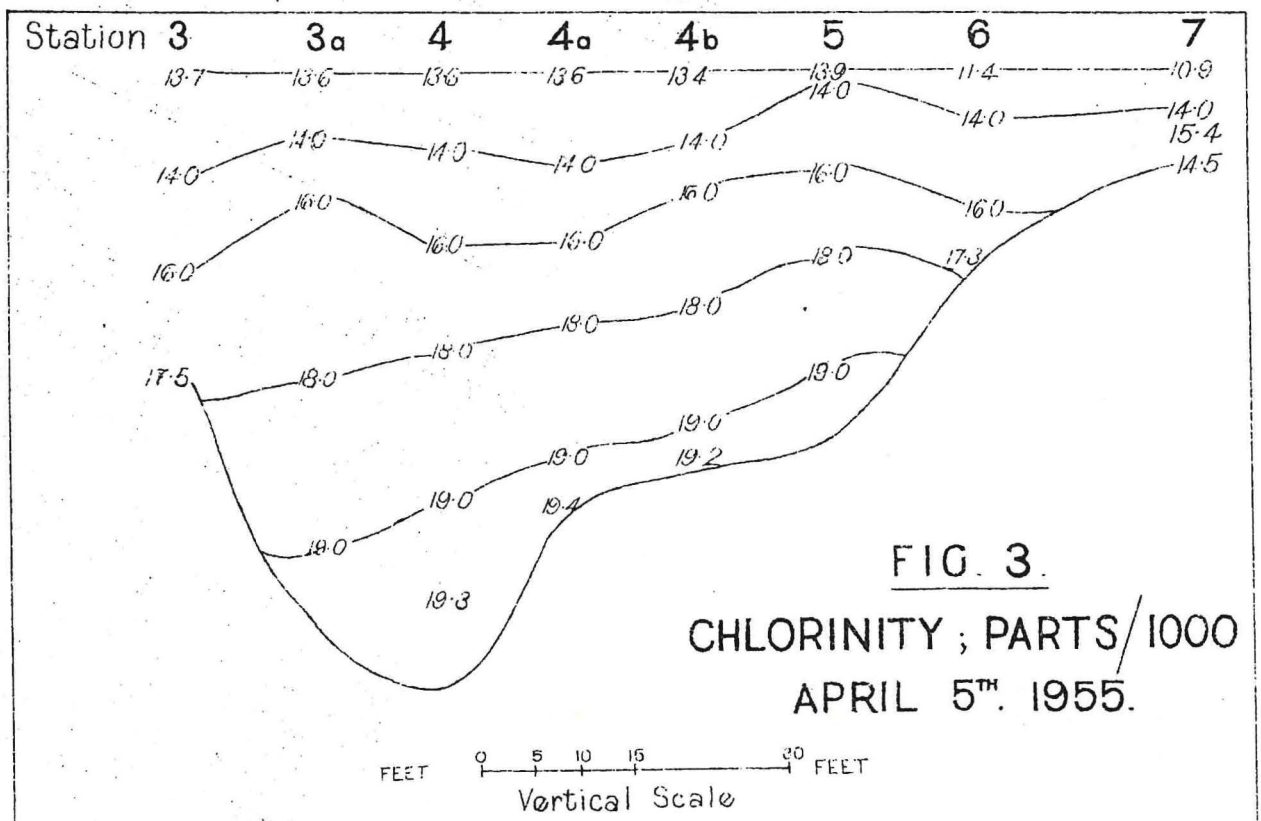


FIG. 3.

CHLORINITY ; PARTS/1000

APRIL 5TH. 1955.

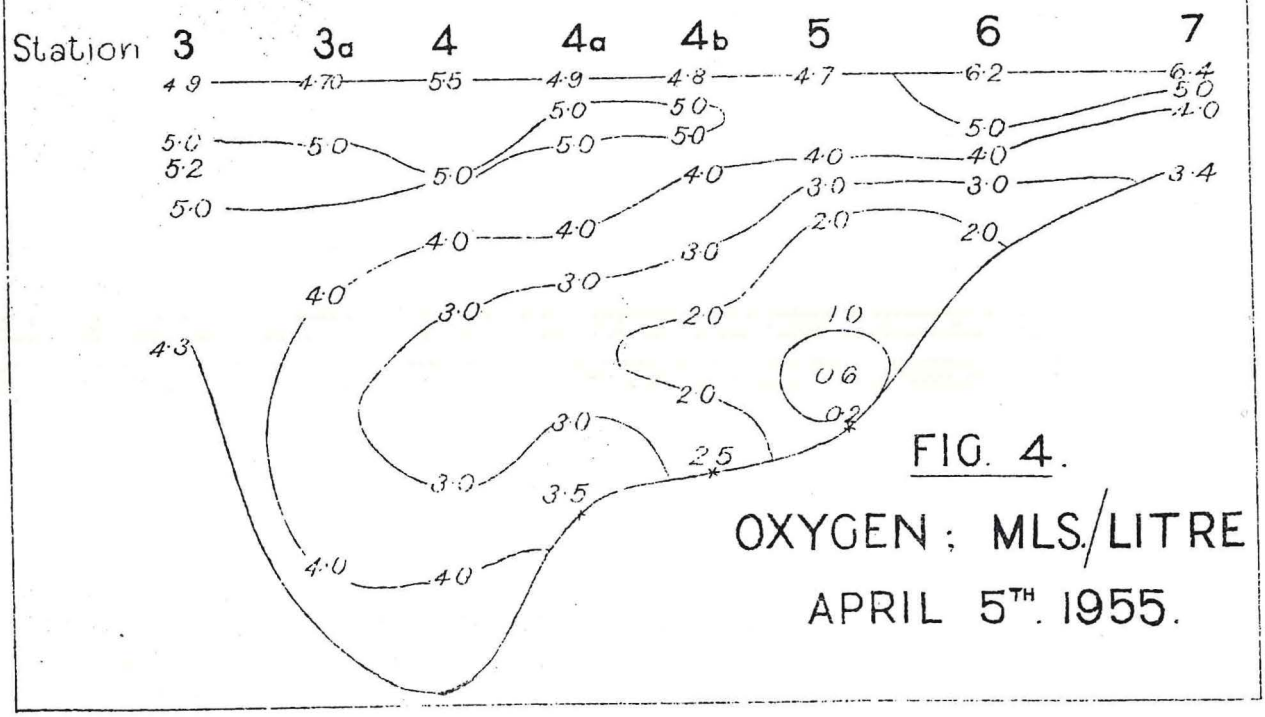


FIG. 4.

OXYGEN ; MLS./LITRE

APRIL 5TH. 1955.

decreased considerably due to mixing with the oxygen-rich marine water, and that the 3.0 and 4.0 mls/litre lines have been forced nearer to the surface at Stations 6 and 7.

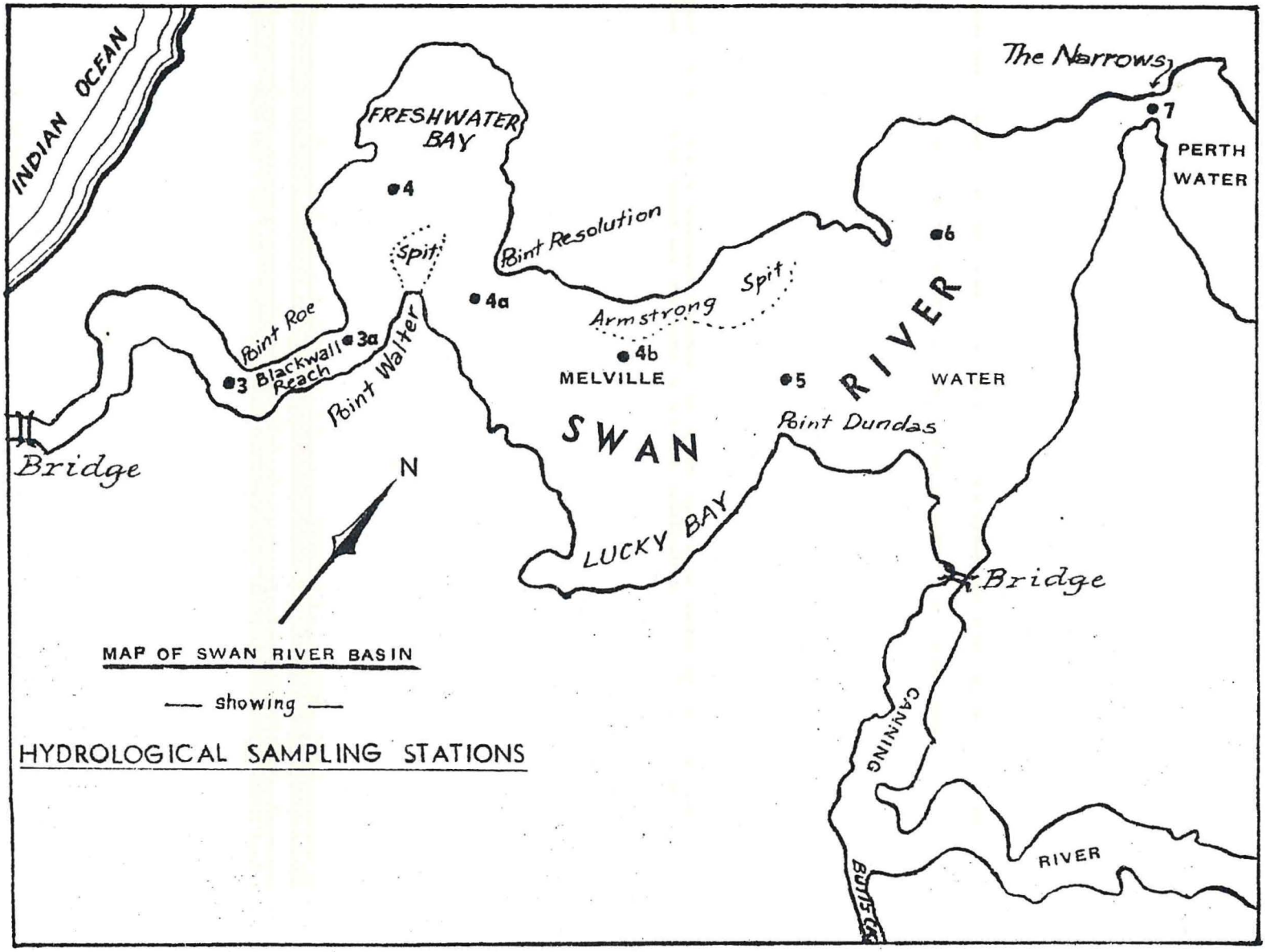
The bottom penetration of marine water is even better illustrated in Figure 3, from which it can be seen that water of chlorinity 19.0 has penetrated upstream past Station 5, and that the 14.0 chlorinity line has risen to a depth of less than 7 feet at Station 6 and is now as far upstream as Station 7. Further, there is now water of chlorinity 15.5 at Station 7, whereas 5 days previously on March 31, the highest chlorinity at Station 7 was only 13.5.

Figures 3 and 4 give a picture of the estuary as it was on April 5, 1955, three days before the major outbreak of fish mortality in Perth Water. From April 5 the tide height steadily increased due to a falling barometer, until on April 8 the tide height, as recorded by the P.W.D. tide machine at Mill Street, was the maximum for April.

As previously stated, an increase in tide height means an upstream movement of the basin waters as a whole and a consequent raising of the lower waters to nearer the surface as the water depth decreases.

With the water distribution in the basin as it was on April 5, the progressively increasing water level apparently caused some of the desaturated waters to be forced up into Perth Water where the depth is such that the low-oxygen, high-salinity waters actually appeared at the surface. Samples collected on April 7 off the P.W.D. jetty at the foot of Mill Street, where the depth is only $3\frac{1}{2}$ feet, had salinities of 18.0 parts/1000 and oxygen tensions of 0.7 mls/litre.

From the diagrams it can be seen that the surface chlorinity steadily decreases and the oxygen tension steadily increases as we proceed upstream. Moreover, the surface salinity and oxygen at Station 7 on April 5 were 10.9 and 6.4 respectively. But the Perth Water figures on April 7 were 18.0 and 0.7 respectively, which means that this water must have been derived from a point downstream of Station 7.



MAP OF SWAN RIVER BASIN

— showing —

HYDROLOGICAL SAMPLING STATIONS

The salinity-oxygen ratio suggests that this water originated from a depth of about 23 feet, possibly at Station 5, and was pushed upstream by tidal pressure.

(4) Discussion

The possibility that this oxygen deficient water may have been derived from some discharge into the river was not overlooked, and as the notorious Mill Street drain was adjacent to the affected areas its discharge was analysed. The discharge was found to have an oxygen tension of zero and a salinity of 4 parts/1000. If the low oxygen tension in the adjacent waters was due to dilution by this discharge, we would also expect the salinity to be lowered accordingly. As we have seen this is not the case; in fact the salinity is much higher than we would expect and hence the possibility of contamination from the drain must be ruled out. Furthermore, in the case of the Bull Creek and Como phenomena, no drains enter the river at or near the affected areas, and hence the effect of drain discharge must be ruled out.

(5) Conclusion

To conclude, we may say, on the basis of the somewhat limited evidence at our disposal, that the abnormal fish mortality outbreaks referred to herein were most probably caused by their environment becoming temporarily contaminated with oxygen-deficient water derived from the deeper parts of the basin, this water being forced upstream by tidal pressure most likely associated with low barometric pressures.

This report is of necessity brief and the analytical data, tidal records, etc., will not be included. A list of the hydrological sampling stations is however necessary and is included as an appendix. Their approximate locations are shown on the accompanying sketch map.

(6) Appendix

Station	Location	Depth
3	In channel off Point Roe (Billygoat Farm).	30 feet
3a	In channel at north-east end of Blackwall Reach.	60 "
4	In channel off Point Walter Spit.	66 "
4a	In channel off Point Resolution.	45 "
4b	In channel off Armstrong Spit.	43 "
5	In channel off Point Dundas.	40 "
6	In channel off Knot Spit.	20 "
7	The Narrows.	10 "

THE GREENOUGH BREAKS THROUGH

Inspector S.W. Bowler has advised that the Greenough River has broken its sand bar for the first time for two years and is flowing into the sea.

RARE SHARK RAY

Last month Pearling Inspector M. Goodlad, of Broome, sent a shark ray, or bow-mouthed angel fish, to the Perth Museum. The ray, which was about 6 feet long and dark grey in colour, had numerous white spots on its body and fins. The Director of the Museum, Mr. L. Glauert, said that although the fish was a rare one it had a wide distribution in warm waters extending from East Africa to China. It had two remarkable bony crests between the eyes and five behind the front part of the body. Mr. Glauert said that the pectoral finswere small in this species which carried its front dorsal fin on the rear of the body instead of on the tail.

THE CLEARING HOUSE

Drift Card Clues to Coastal Currents

by L.T. Sardone.

Australian scientists are gathering information on ocean currents and conditions by means of a new mail service from the sea. Every month they strew selected areas of eastern Australian waters with dozens of special drift cards - like postcards - bearing identifying numbers.

These flimsy-looking objects become the playthings of every tide and current, and many are washed ashore. Finders are invited to fill them in, post them, and claim a reward for doing so.

This distribution of drift cards is playing an important part in the oceanographic investigations the Fisheries Division of the Commonwealth Scientific and Industrial Research Organisation is making.

Having had a keen interest in bottle messages ever since boyhood, I visited the HQ of the mail service - the C.S.I.R.O.'s main fisheries laboratories at Cronulla, on Port Hacking, 22 miles south of Sydney. The hydrologist, dark, thick-set David J. Rochford seated me in a comfortable chair and warmed up enthusiastically about his (water) baby.

"This postcard idea is new to Australia," he told me. "We borrowed it from overseas. It was devised by F.C.W. Olson, of the Oceanographic Institute of the Florida State University, in America. He first used it in 1950 in experiments in Western Lake Erie. South African scientists then made a series of exhaustive tests, and found drift cards extremely reliable."

They replace the old technique of sealed bottles - the traditional bottle messages of the sea. Drift cards are much cheaper and easier to handle. A crate of 50 bottles half-filled with sand takes up a lot of room, "and gets a bit heavy to lug around,"

Rochford laughed, wiping his spectacles. "You can put 50 of these cards in your pocket."

Cards, too, are much less likely than bottles to be pushed about by surface winds because they lie flat on the water. They bring a much higher percentage of returned messages - up to ten times as many.

Each card is slightly more than 5 ins. by 2 ins., sealed in a water-proof envelope of clear, polyethylene plastic, the same as that used for high-class food wrappers. These envelopes can remain immersed in salt water without harm for at least six months. Each card bears its serial number - David Rochford handed me No. 15476 - with a series of questions the finder is invited to answer by filling blank spaces. These include the finder's name and address; the place and date where found; the amount of seawead or other marine growth on the envelope, and whether such growth was alive or dead.

Drift cards were coloured pink when first released in October, 1952, until albatrosses, gannets and other diving birds in the offing at launching avidly pounced on them, puncturing the envelopes and rendering the cards useless. The present blue cards merge with the water and become less attractive to hungry, excitable seabirds. Fish ignore them.

Drift card finders are asked to slit the envelope, fill in the details, then slip the card into the nearest postoffice. The address is printed on the reverse side. Rochford says the Fisheries Division pays 2/- for each card returned. Some finders send in a dozen at a time. None as yet have been picked up by ships.

Frequently some card sent in from some fairly isolated coastal region is accompanied by a lengthy, irrelevant letter winding up with a cordial invitation to "drop in any time and stay a few days." Correspondence and visitors are both sparse where these finders live and they become excited over the new interest in life these marine messengers have brought them.

The Division's field staff have launched more than 15,500 cards to date, and are distributing them at the rate of 25 a month at fixed points called stations, five miles offshore. The men charter fishing boats to

do the job and at the same time take bottles of sea-water samples, and plankton with various types of net.

These stations extend from Evans Head, northern N.S.W., down to southern Tasmania. The longest distance any card so far has drifted has been along the N.S.W. coast from offshore at Coff's Harbour to inshore at Camden Haven, about 100 miles. Cards have yet to equal two bottle drifts I saw charted in Rochford's office. Launched off the Tasmanian coast and caught in the westwind drift, one was picked up 30 miles off Stewart Island, South Australia, more than 1500 miles.

"Why," I asked, "do the majority of cards travel much shorter distances?"

"Because of frequent summer northeast winds which tend to carry objects towards the shore-line," Rochford replied. "During winter and the lesser frequency of onshore winds, the cards are borne by currents to points further south."

Results come in usually within a fortnight of release. Recovery percentage varies greatly. During winter it is very low - almost nil. This doesn't necessarily mean that cards are not coming ashore; it is due solely to fewer people being about on beaches. The cards, too, are not as conspicuous as bottles.

Rochford doesn't place much reliance on time lapse; a card may lie stranded on a beach for weeks before being picked up.

Station field men log cards as released. Cronulla laboratory staff then carefully record these details in a most efficient filing system. They soon check and identify returned cards by number, and plot their movements on charts - each a little larger than a tabloid newspaper. They also take a note of marine growth, if any, but Rochford tells me that until a card has been immersed at least three months, very little growth adheres. Cards don't offer as much surface as bottles do, and anyway if too much adhered, the card would sink and be lost.

"What are we trying to get out of all this?" Rochford echoed my query. "By returning these cards," he explained, "finders will be assisting a research project that is intended to provide a clearer, more exact picture of the pattern of the ocean currents of eastern Australia. We're trying to decide when these coastal water movements travel north, when south, and also when they remain purely local. We know from other evidence that these movements do occur, but drift cards will confirm existing theories as to when and to what degree. They may also confirm theories we have regarding the salinity and temperature of coastal waters."

As part of this investigation officers of the Huddart Parker liner Wanganella are collecting samples of seawater on the run to and from New Zealand.

The NZ Oceanographic Committee is also releasing drift cards from ships plying the Tasman, and the two bodies co-operate in exchanging information on any recovered.

An important purpose of the study is to provide scientists with sufficient data to enable them to develop an oceanic prediction service. Rochford hopes it will become possible to forecast conditions, within reasonable accuracy, up to three or six months ahead.

These oceanic conditions are related to seasonal movements and fluctuations in the natural stocks of fish. Such predictions, then, should be a valuable guide to commercial fishermen, particularly those exploiting such species as tuna for canning.

("Better Business", Brisbane, June, 1955.
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Business Directories (Aust.) Pty. Ltd.)

Predatory Birds Help and Hinder South African Fishermen

Predations of the South African pilchard by seabirds has led to an investigation into the feeding habits of the fish-eating birds of the St. Helena Bay area, off the west coast of the Union.

Of eleven species of birds investigated,

three were considered to be important predators of commercial species of fish, particularly of the pilchard. They are the Cape Gannet, the Cape Cormorant and the Cape Penguin. Their damage to the fishing industry is estimated at about a million pounds a year.

No steps are to be taken at present to control sea-bird predators off the west coast, and protection, now accorded to sea-birds, will not be relaxed. Further research is to be carried out in relation to both predators and prey, to be extended to include the fisheries of S.W. Africa.

Live up to Their Name

Estimates are that the population of gannets feeding in the St. Helena Bay area is around 200,000 birds, which eat a total of 73,000 tons of fish per year, of which 37,000 tons consist of pilchards and 12,000 tons of Maasbankers.

"These amounts represent about one quarter and one seventh respectively of the total commercial catches of these two species landed in the Union for the year 1953.

"The population of Cape Cormorants feeding in the St. Helena Bay area is estimated at 30,000 birds, which eat a total of 3,660 tons of fish per year, 1,800 tons of pilchards and 550 tons of maasbankers, representing about one-80th and one-170th respectively of the total commercial catches for 1953." He adds that these figures are partly based on estimate and must be regarded as tentative.

Over Exploitation

Mr. Davies, senior professional officer, comments "In pelagic fisheries no clear-cut scientifically proved case of over-fishing has so far been established." Declaring that the tendency for increased exploitation "of all known and unknown fishing stocks" is universal, he says that recently there has been advocation of rigorous control of predators. "The main object of such control is to make the amount of the prey which is normally consumed by the predators available for the commercial fisheries and so increase the fishing potential.

Mr. Davies gives a warning, however, that predation is one of the most powerful forces in nature and is usually responsible for maintaining a balance of the prey population. "For example in restricted waters it has happened that the entire removal of predators has resulted in an over-abundance of prey, far too numerous for the available food supply. This has, in consequence, had disastrous effects on the prey population."

On the basis of the scientific findings set out in the report, Mr. Davies estimates the consumption, on a conservative basis, by the gannets and cormorants of the St. Helena Bay area at 51,350 tons of fish of commercial importance per year. The fish eaten by the birds, he also estimates, would be worth £205,400 in terms of landed value and nearly £1 million in terms of final fishery products.

("The Fishing News, London, May 27, 1955.)

Food From Algae

by R.T. Lange.

Research into algal culture for artificial food production is well justified by its basic theory. In addition, standard agricultural methods cannot be expected to increase food output at a rate matching that of world population increase, and supplementation by unconventional means must be considered.

Basic to food production is the photosynthesis of an elementary carbohydrate from inorganic water and carbon dioxide, using the energy of sunlight, and only green plants can perform this synthesis. The land plant devotes much of its photosynthetic products to providing a supporting skeleton, and only a small part of its total weight can be recovered as food. Its productivity is seasonal, it is sensitive to exposure and complete control of its requirements is practically impossible outside of hydroponics. Hence the photosynthetic yield to man is restricted by factors affecting the plant, and by the plant's own

structuring of synthesized carbohydrate into forms unsuitable for animal digestion.

If Photosynthesis could be duplicated in industry, no wastage of products or cessation of synthesis need occur, and greater food production would result. However, the complexity of the synthesis is beyond our present standard of technology.

It was with the recognition of the algal unicell types as plants almost entirely photosynthetic - lacking to a large extent accessory non-synthesising tissues - that industrial photosynthesis became a technical possibility.

These unicells live suspended in water, and any species of Chlorella is typical. A unicellular green alga, it is spherical, from five to seven microns (one micron equals one-millionth of a metre) in diameter and possesses a chloroplast, single nucleus and cellulose wall. Reproduction is by simple division, occurring under optimum conditions about every fifteen hours. Though individually extremely small plants, in nutrient solution they occur in densities from five to ten million individuals per cubic centimetre. Carbon fixation is an integral part of food production, and marine growth, primarily algal, fixes some one hundred and fifty-five thousand million tons of carbon annually - over ten times the quantity fixed by all land plants in the same period. The bulk of this fixation can be attributed directly to planktonic algae of equivalent size, giving ample support to the theory that unicells would be produced in sufficient number to warrant culture.

Algae as a Crop

Growth resulting from accumulation of organic molecules synthesised is in the numbers and size of the population, and not in the size of the individual. As the cells are supported by water and have no need of a skeleton, protein content up to fifty per cent of the dry weight is common. Productivity is not seasonal, and with nutrients and carbon dioxide supplied in the water, optimum production with minimal wastage can occur. Periodically removing the bulk of the cells from the culture would be equivalent to harvesting a land crop.

Work done to assess the technicalities and practicability of industrial culture is as yet indecisive. The studies are recent, and not yet past the pilot plant stage, but they do indicate the type of problems involved. The basic requirements for large-scale culture consist of a solution fully supplied with the major nutrient salts and traces of other elements, for elaboration of complex molecules from the elementary carbohydrate. Carbon dioxide and light for the carbohydrate synthesis are also necessary, and the optimum temperature for growth of Chlorella types is about 25° C.

Achieving optimum balance of these is not sufficient. Accumulation of photosynthetic products is necessarily accompanied by cell division, and growth of the population in numbers. Agitation is necessary to ensure rapid separation of daughter cells, their suspension in the medium, and to avoid prolonged shading of any cells. The culture grown, it must be harvested and stored.

Methods of Algal Culture

In Germany, an open-air system of culture in plastic lined trenches was attempted, bubbling industrial carbon dioxide with air into the medium, and relying on this for agitation. In England, cultures in tall cylinders, tubes and a plastic tank were supplied with carbon dioxide by bubbling, while in Japan a plant consisted of a concrete trough covered with a transparent plastic sheet, and a carbon dioxide counter-current tower and through which the culture from the trough was circulated. American workers have pumped a culture through long broad polyethylene pipes, introducing carbon dioxide and salts as required.

Although results so far obtained do not indicate algal cultures to be an easy method of food production, one must consider the comparative infancy of the study. Perhaps advances in technology will reduce culture costs to a competitive level, when controlled photosynthesis might well assume great importance as a food source.

("Scope" Perth, Western Australia. June, 1955)

New "Fish-Pump" Experiments Use Electrical Device

A U.S. research vessel has been experimenting with the use of a "fish pump" in combination with an alectrical guiding device, and has found that there is considerable room for further investigation. The vessel fished herring in Puget Sound and off Cape Flattery last winter.

by Keith Smith
Gear Development Section,
U.S. Fish and Wildlife
Service, Seattle.

Results of fishing experiments using gear designed for pumping fish in combination with an electrical-guiding device and an automatic light dimmer show that, in calm waters, small herring can be attracted and caught in a pump by use of a light for attracting them and a direct-current : lsating field for guiding them.

These fish are not repelled at the outer fringe of the elœtric field. Instead, when attracted by the light they enter the field to a point where they involuntarily swim to the anode and are swept into the pump by the flow of water.

The gear took fish most successfully when both the underwater light and pulsating field were in operation. Small catches, however, were made using light alone. Sudden movement of the light and electrode assembly frightened the herring away. Thus, movemont such as that caused by the rolling of the vessel prevented the herring from approaching the gear closely. Dimming the light did not cause herring to approach closer. The best catches were invariably made in the early morning during the approach of daylight.

Background of "Pump" Experiments

With gear designed for pumping fish from the sea, experiments were conducted aboard the U.S. Fish and Wildlife Service's exploratory fishing vessel "John N. Cobb" in the fall of 1952. At that time some success was obtained using two 1000-watt underwater lights to

attract fish to the pump intake. A maximum of about 1000 fish was caught in one night's operation of the pumping gear between the hours of 8 p.m. and 6 a.m.

Another series of tests was carried out using the same gear in combination with an electrical guiding device and an automatic light dimmer during October and November, 1954. Since various workers have demonstrated that fish can be led to a positive electrode by pulsating direct current, it was believed that this reaction of the fish to electrical stimulus might be used to lead them into the intake hose of the "fish pump."

Preliminary studies were made in the summer of 1953 on the conductivity of sea water and the pattern of electrical current flow through it. These studies, made by Duane Chadwick and Joseph Christie, graduate students in electrical engineering at the University of Washington, indicated that it was possible to produce with the amount of power available on the "John N. Cobb" the desired electrical current flow through a limited space of seawater.

Gear and Equipment

The pumping arrangement consisted of a 4-inch bladeless-impeller pump coupled to a 5-horse-power electric motor. The pumping capacity was 220 gallons of water per minute. The intake hose was passed through a closed chock into the seawater, and the discharge hose was run to the receiving tank and firmly fastened.

The receiving tank was built on the after deck. This tank was 8' wide, and 13' long, and could be filled to a depth of approximately 10 inches when the vessel was in calm water.

Tests were made with various temporary lighting and electrical guiding arrangements. These tests indicated that both lighting and electrical guiding were necessary to lead fish into the pump intake. Without the light, fish were not attracted to the electrical field, and only those advertently entering the field were caught.

With the light on, but with no electrical field applied, most of the fish that had been attracted to the light were able to escape. The water current near the intake was not so swift as to sweep a large number of fish involuntarily into the pump. On the contrary, when the fish felt the water current, most of them were able to swim against it and thus avoid being captured.

Operation and Results

With the fish attracting, guiding, and pumping gear, 29 tests were made in Puget Sound and off Cape Flattery. These tests were run for varying lengths of time. The tests in Puget Sound were made in areas in which schools of fish were indicated by feeding birds and by tracings of an echo-sounder. The tests off Cape Flattery were set "blind" in outside waters on Swiftsure Bank and in Mukkaw Bay.

The gear was put into the water at nightfall; the underwater light was turned on; and a watch was kept to observe any fish that rose to the light. The assembly was suspended in the water by a single cable from the boom at a depth of 5 to 15 feet, the whole apparatus lying in a horizontal position parallel to the axis of the boat. When the assembly was suspended at this depth, the reactions of the fish in the lighted space could be observed from the after deck if the surface of the water was relatively calm.

When a school of fish began to enter the field of light, the pump was started, and the electric pulse was turned on. Fish present between the electrodes within approximately 2 feet of the anode turned involuntarily and swam toward the anode. As these fish approached to within 2 or 3 inches of the open end of the funnel, they became stunned by electrical shock and were carried into the funnel by the flow of water. Fish continuing to rise to the light were caught in the electrical field and led to the anode in this manner. Under ideal conditions of tide, wind and availability of small herring, the fish rose up to the light and into the pump in a continuous stream.

At such ideal times, small 3-inch herring were caught at a maximum rate of 1,178 fish per minute or 70,720 per hour. The average rate of catch for the

5 best catches made on 4 different nights was 717 fish per minute or 43,022 fish per hour. Catches ranged from these values down to 0, the better catches always being made between 4 a.m. and 6 a.m. during the approach of daylight.

The fish caught were predominately herring and, with the exception of 14 fish ranging from 6 to 8.7 inches in length, were all of a uniformly-small size. They averaged 3.05 inches in length and were in their first year of life as determined by scale analysis. Individual larger herring 6 to 7 inches in length were occasionally seen at the periphery of the lighted space at a distance of approximately 12 feet from the light. Only very rarely was a fish of this size caught.

The better catches were almost invariably made when both the light and electric pulse were in operation. In one test, however, 26.5 pounds of herring were caught in 20 minutes using only the light.

Small numbers of anchovies and eulachon were caught along with the herring.

Gradual dimming of the light was tried in hope that the fish, particularly the larger ones, would rise nearer to the light as it became dimmer. Such a reaction was not observed, however, during the tests conducted. The herring seemed best attracted when the lamp was operated at its full brilliancy. Tests using more than one lamp, however, did not result in an increased catch.

The light could apparently be used at only one position to best advantage. The maximum catches were made with the light placed 12 inches in front of the anode and 18 inches above the center of it. When additional lamps were used at other positions, catches were not increased.

A number of uncontrolled factors influenced the catch. The more important of these were: (1) availability of fish, (2) presence of predators, (3) movement of the vessel caused by wind and tide (any movement of the light and electrode assembly, which was suspended from the vessel, frightened the fish) and (4) the changing time of day (herring were observed to approach the light in greatest numbers for a period of approximately 1 to 2 hours at daybreak).

As the fish came out of the discharge hose into the receiving tank, an estimated 60 percent of them were marred either by physical abrasion while coming through the hose and pump or by electric shock, or by both. It is likely that any fish that made a firm contact with the anode was electrocuted. Bruised and descaled areas were observed about the head and along the back of both live and dead fish.

No herring were observed in the outside waters off Cape Flattery, and the tests there were unsuccessful. Even if herring had definitely been present, however, the movement of the gear caused by the ocean swell and chop would probably have frightened them away. Hence gear of a different design should be tried if experiments on electrical attracting and guiding of fish are to be conducted dead or dying. These fish were killed in open ocean waters.

More experimental work is required before the method can be applied to catching fish on a commercial basis.

Further Investigation

The use of monochromatic lights to attract and guide fish to a point of capture might be tried. Experiments with various colours of light might lead to the discovery of a wave length that is much more effective than is white light.

The use of sound for fish attraction also presents a field for investigation. Sounds of the proper controlled frequency and intensity applied under water may result in the attraction of certain fish.

Knowledge is needed of the pattern of electrical current flow through an unlimited space of seawater, the amount of current per square inch necessary to guide fish of various sizes in seawater, and the optimum size and shape of, and distance between electrodes.

For work in the open ocean where the attracting and guiding assembly is subjected to the swell and the chop of the seas, a method of support must be designed which will leave the assembly independent of the vessel's motion. This support should also be

designed to hold the assembly at a constant level in the water where it will be unaffected by movement of the surface of the water.

("Western Fisheries" Vancouver, B.C. May, 1955)

Draft on Fishing Limits and Coastal Claims Now Prepared

The draft regulations on territorial waters has now been prepared by the International Law Commission sitting at Geneva and will be presented to the United Nations General Assembly. This draft, even if approved, will not be mandatory.

The claims of some Latin-American and other countries to sovereignty over exorbitant expanses of territorial sea may be moderated, says the Times Geneva correspondent. The emphasis in the new fisheries rules drafted by the International Law Commission is on the need to conserve the fisheries, and any regulations which the coastal State imposes to that end will have to be based on scientific evidence and must not discriminate against foreigners.

The draft - largely the work of Dr. Garcia-Amador (Cuba) - seeks to reconcile the rights of the coastal State to the traditional freedom of the seas, says the correspondent. It gives the coastal State the right to take unilateral action for fisheries conservation off its shores, but protects other States' interests (whether they fish in the waters or not) by establishing a system of compulsory arbitration in disputes that cannot be settled by other means.

("The Fishing News" London June 17, 1955)