accurately weighed sample of the dye was dissolved in ethanol (about 0.1 g per 100 ml) and a 0.50-ml aliquot was placed on a 1-in. square of filter paper. As soon as the ethanol had evaporated, the paper square was placed between gummed paper labels. This was placed in direct contact with the Geiger-Müller tube with a tight rubber band. The Geiger-Müller tube was calibrated by counting in identical fashion an aliquot of the original I^{131} solution which had been assayed at the Oak Ridge National Laboratory. The activity of the dye, measured in this manner, was 0.55 mc/g.[3]

This radioactive dye has been administered to tumor-bearing experimental animals and to a small number of human subjects. Results appear elsewhere (*4*).

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Occurrence and Life Histories of Commercial Shrimp

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Grooved shrimp (*Penaeus*, Division II) are unusually prominent in the North Carolina catch. Study of the species has been impeded not only by lack of means to distinguish them from each other before adolescence (or to distinguish their eggs and larvae from those of the ungrooved *P. setiferus*, with which it seems possible that Pearson (*3*) has confused them), but by lack of means for rapid field identification of adults. A simple diagnostic test for the commercial sizes of the two grooved species common in continental North America is that *Penaeus duorarum* Burkenroad, the spotted shrimp, bears a reddish brown midlateral patch at the juncture of third with fourth pleonic segment. This pigmented spot, first called to my attention by Captain O. Purifoy, is larger and denser than the one at the midlateral hinges that lock the other pleonic somites together, or the one at the equivalent site in *P. aztecus* Ives, the brown shrimp. Field confirmation of the rapid diagnosis is seen in the difference between the common North American forms of these two species in width of groove alongside the mid-dorsal carina of sixth pleonic segment (*1*).

No special fishery for spotted shrimp has previously been described. A 10-year-old one in the shallow Straits between Core Sound and Beaufort Inlet, North Carolina, employs some seventy channel nets, like boardless, long-winged otter trawls, which are staked or anchored in strong tide-currents during night ebb in May, June, and July. These stationary tide traps intercept shrimp swimming off the bottom (presumably migrating to sea). A catch of over a ton by one 75-ft net on one ebb has been reported, but the annual production of the whole fishery is probably around 100 tons. The catch, especially prized for hardness, sometimes contains a proportion of brown shrimp but is chiefly immature *P. duorarum*. Since grooved shrimp in the North Carolina commercial trawl catch are mostly *P. aztecus*, the tide traps evidently select the spotted species from an inshore and inside grooved shrimp population which is as a whole preponderantly of brown shrimp. There is evidence, however, that young spotted shrimp are in the majority on the shallowest bottoms of the saltier sounds.

During the last decade, the proportion of grooved shrimp in the annual North Carolina catch has probably fluctuated between a third and a half. Brown shrimp have always been prominent in the catch of Carteret County, but testimony from fishermen suggests that since 1936 these shrimp have become absolutely, as well as relatively, more abundant not only there but on the grounds farther south around Cape Fear, which before 1936 supplied a larger share of the state's catch, including a higher proportion of the gray shrimp, *P. setiferus*. Since there are indications of unusual abundance of *P. aztecus* during the same period along its whole Atlantic Coast range, it seems possible that the population of this species has undergone a recent increase. Such an increase may have contributed to the development since 1936 of an extensive new fishery in Pamlico Sound. This, the most northern American market fishery for peneid shrimp, sometimes supplies more than a third of North Carolina's production, chiefly from a summer run of relatively large brown shrimp.

Brown shrimp in North Carolina shoal-water catches are often nearer maturity than is usual along the more brackish shores of Louisiana, but the spawning grounds of the North Carolina population have not yet been found. Sporadic offshore catches of jumbo shrimp by winter fish trawlers in the Hatteras-Lookout area are chiefly of gray and of spotted shrimp; and a reliable and widely experienced North Carolina fleet owner, Mr. L. Hardee, who has encountered the abundant, though scattered, orange-colored, yellow-roed breeding population of *P. aztecus* present off Louisiana in 15–70 fathoms the year round (*1*), does not know of a North Carolina equivalent.

Although this apparent scarcity of adult brown shrimp off North Carolina may simply reflect the inadequacy of exploration, it is not necessarily inconsistent with the high density of the state's inshore immature population. Half-grown brown shrimp appearing in New Jersey in midsummer are evidently postlarval immigrants (*1*). It is therefore conceivable that North Carolina brown shrimp, in contrast to the endemic spotted kind, chiefly originate farther south.

It should be observed that, as long as the Atlantic habitat of mature brown shrimp remains unknown, the belief that there is no extensive Atlantic deepwater population of gray shrimp (*4*) cannot be regarded as

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[3] Miss Ruth E. Brown assisted with the radioactivity measurements.

unquestionable. There is also some basis for questioning the related belief (*2*) that *P. setiferus* normally dies after only one or two spawnings, and without surviving a second winter; since the gray shrimp, like the brown, continues to molt after beginning to spawn; and since a large proportion of adult females, including many nearly ready to spawn again, already show traces of previous spawning in early spring.

King's suggestion (*2*) that nature has failed to make "proper provision for the egress" of the eggs of *P. setiferus*, evidently results from failure to detect ripe eggs left behind in the spawned ovary except when retention was abnormally great. Normally, there is only a sparse scattering of leftover ripe eggs (*1*). For example, among a sample of 67 unripe and ripening hard-shelled North Carolina May adults, most or all of which had spawned previously, such eggs could be detected in 26 by teasing 0.1 ml ovarian samples. The average number of leftover eggs per positive sample was less than two, and the maximum ten.

Remains of spermatophores attached to female gray shrimp offer a second clue to previous spawning. These remains are of two distinguishable types: glutinous remnants grading up to large fragments, and found only in some of the very ripe, which are evidently from recent spermatophores accidentally torn away before spawning; hard traces, never conspicuous, and least frequently detectable in ripe individuals, which are evidently left after normal spermatophore dissolution at spawning. In a sample of 99 unripe and ripening hard-shelled females from the same catch as and including the 67 examined for leftover eggs, 82 bore recognizable spermatophore traces. Since those lacking spermatophore traces bore leftover eggs in about the same percentage as did the whole sample, and vice versa, it appears that even among those not displaying either indicator, most or all had spawned before.

Among very ripe females of the same catch, minute spermatophore traces were detectable in 15 of 31 closely examined. The catch (trawled near shore at Cape Fear in late May, 1949, by Mr. Carter Broad of the Institute of Fisheries Research) included a total of some 130 very ripe, 160 ripening, and 120 unripe adult females. None of this particular catch seemed newly mated or newly spawned. Seven, all unripe, were soft-shelled; of which three had leftover eggs.

It will be seen that the previously misinterpreted distribution of spermatophore traces among female gray shrimp from deepwater catches off Louisiana in March (*1*) suggests the presence of survivors of the preceding season's spawning.

Xiphopeneus kroyeri (Heller), sometimes abundant in Louisiana and a prominent commercial shrimp of Brazil, has not been previously reported from North Carolina. Three ripe females of this species occurred with the catch from Cape Fear, just mentioned.

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Periodate Oxidation in the Study of the Structure of Dextrans

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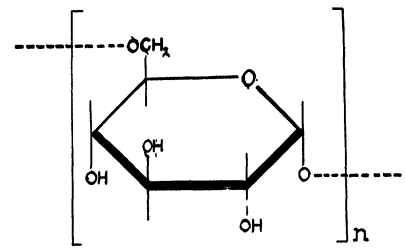
It was predicted by Brown *et al.* (*1*) that pyranoid 1–6 polyglucosans (dextrans) should behave in a distinctive manner toward periodate ion by means of which dextrans may be distinguished from other polysaccharides. Oxidation with potassium *m*-periodate cannot be utilized for the determination of the mean chain length since each 1: 6-glucopyranose residue undergoes oxidation with the liberation of 1 mole of formic acid by virtue of the fact that each such residue possesses hydroxyl groups on three contiguous carbon atoms. Thus, a "straight chain" 1: 6-polyglucose, provided that all the units are pyranose, will behave in a manner analogous to a methyl glucopyranoside as far as the production of formic acid is concerned. It follows that the equivalent weight of such a dextran, i.e., the weight of material yielding 1 mole of acid, will be numerically equal to the equivalent weight of a single glucose residue, viz., 162.



However, any 1–6 glucose residue which is triply linked and thus constitutes a point of branching in the molecule, will not yield formic acid no matter whether the side chain be attached at C_2, C_3, or C_4. (This will also be true for any furanose units or residues linked other than 1: 6-). The presence of numbers of such points of branching will be manifest in an experimental value for the equivalent of a dextran greater than the calculated value. From the difference in these two values it should be possible to determine the ratio of branched residues to straight residues.

A detailed study of the periodate oxidation technique has been carried out by Pacsu *et al.* (*5*) in which the limits of accuracy for the determination of formic acid in the presence of comparatively large amounts of reducing substances have been defined, the best results being obtained by titrating potentiometrically to a given pH. In the case of the dextrans, the total amount of formic acid liberated is considerable (cf. oxidation of starch) and it is not until the end point is reached that interference from other products of oxidation becomes significant; notwithstanding this, the total amount of acid can be determined with considerable accuracy.

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