Michigan DNR

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

Number 2001-1

December, 2001

Aging Scales of Walleye, Yellow Perch, and Northern Pike

James C. Schneider

www.dnr.state.mi.us

FISHERIES DIVISION

TECHNICAL REPORT

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

Fisheries Technical Report 2001-1
December 2001

Aging Scales of Walleye, Yellow Perch, and Northern Pike

James C. Schneider

For information or assistance on this publication, contact the Michigan Department of Natural Resources, Fisheries Division, Box 30446, Lansing, MI 48909, or call 517-373-1280.

This publication is available in alternative formats.

Printed under authority of Michigan Department of Natural Resources
Total number of copies printed 200 — Total cost $1,039.96 — Cost per copy $5.20

Michigan Department of Natural Resources
Fisheries Technical Report 2001-1, 2001

Aging Scales of Walleye, Yellow Perch, and Northern Pike

James C. Schneider

Michigan Department of Natural Resources
Institute for Fisheries Research
Museum Annex Building
Ann Arbor, Michigan 48109-1084

Abstract.–This report discusses difficulties in determining the age of walleye *Stizostedion vitreum*, yellow perch *Perca flavescens*, and northern pike *Esox lucius* from scale samples. It recommends procedures and offers tips to improve success. Photocopies of known-age specimens are included to illustrate scale patterns and difficulties in recognizing true and false annuli. The illustrations may be used as a training exercise.

Determination of the age of fish is one of the most important fisheries techniques, but it is also one of the most subjective. This report provides some tips for aging walleye *Stizostedion vitreum*, yellow perch *Perca flavescens*, and northern pike *Esox lucius* and presents photocopies of known-age fish scales that can be used for reference and training. The known-age material represents a mixture of "normal" and "unusual" patterns. Unusual patterns may be caused by stunting, tagging, pond rearing, or stocking of fish into food-rich waters; these scales can be very difficult to age.

Scales of walleye and yellow perch appear similar and pose similar problems in interpretation. Both are sometimes difficult to age. Scales are reliable indicators of age only when growth has a recognizable seasonal pattern and the fish grow throughout life. Generally, spines, otoliths, opercula, and cleithra are better structures for aging fish than scales, especially when growth is slow (Summerfelt and Hall 1987). However, scale samples are less damaging to the fish, easier to prepare, and satisfactory for most routine management problems. Scale aging provided the information used to establish the State of Michigan growth averages (Schneider et al. 2000). Walleye and yellow perch material included in this report came from a variety of sources, but principally from studies I conducted over many years.

Scales of northern pike are often difficult to age for the same reasons. Cleithral bones usually have a more reliable growth pattern. All information on northern pike included here was extracted from an old report by John Williams (1955) that is not readily available.

Common difficulties

1. Walleye, yellow perch, and northern pike may "stunt". Consequently, annuli may be indistinguishable because they failed to form, were crowded together, or were absorbed from the edge of the scale.

2. Growth naturally slows with increasing age and size. Consequently, the number of apparent annuli may be less than the true age. All three species are relatively long-lived: yellow perch and northern pike may reach 12 years of age; walleye may exceed 20 years old.

3. Males usually grow slower than females, and males (especially) may quit growing after they reach sexual maturity.

4. Because of points 1-3, age estimated from scales tends to be less than true age. Reliability of scale aging often declines after age 4.

5. High variation in growth is characteristic of all three species. Even within the same population, some individuals may grow very quickly and others very slowly.

6. All three species may exhibit spring and fall spurts of growth. This is more common in shallow southern Michigan lakes that become too warm for optimal growth in midsummer and in waters where forage abundance is cyclic. This seasonal pattern is often evident in the second and third years and sometimes in the first and fourth years. A summer check may be formed which can appear as a true annulus on some (but usually not all) scales.

7. Scales of stocked fingerling walleye may show changes in growth (and checks) caused by changes in diet while in rearing ponds, the stress of stocking, and stocking into food-rich waters. It is helpful to take scale samples from a few fish right at stocking, and later that first year, to establish a first-year scale pattern for stocked walleye specific to each water body and year.

8. Because of all of the above, there is much variation in scale patterns among populations.

9. The first annulus may not be clearly visible or consistently located. However, this problem is usually less severe in yellow perch, walleye, and northern pike than in bluegill *Lepomis macrochirus* and species which may spawn over extended periods. Walleye and northern pike usually have a check in the first growing season. In spring collections, especially during the month of May, it may be difficult to distinguish between new growth at the edge and poor growth during last year (i.e., perhaps the last annulus is right on the edge).

10. Not all scales can be aged confidently.

Recommended Procedures

1. Make an extra effort to collect scale samples from small fish, even ones which are obviously young-of-year or yearlings.

   These help the scale reader establish the likely location of the first annulus and may give clear evidence of whether or not this population is prone to checking. This knowledge can then aid interpretation of adult scales. Samples of small fish also provide length-at-age data.

2. Clean, soften, and flatten scales if necessary. Scales may be cleaned by soaking in water and rubbing on paper towel. Make good-quality impressions on plastic (six or so scales per fish). Edges and lateral fields should be clearly visible.

3. Arrange scale samples by increasing fish length. Start with the smallest.

4. Plan to go through all scale samples twice: the first time to obtain a "feel" for the pattern for this population and the second time to assign an age. Difficult scales may require a third examination.

5. On the first run through the envelopes:

   a. Examine several scales per fish to develop a feel for the pattern of this fish, to make sure that scales from other fish have not been mixed in, and to find scales with clear and representative patterns.

   b. Establish the appearance and approximate location of the first annulus from small and clearly readable scales. It is helpful to mark the distance from the focus to the first annulus on a strip of paper or ruler to serve as a rough guide to the location of the first annulus on other, more obscure scales.

   c. Assign tentative ages and make notes on the envelopes about optional ages and possible checks. Examples: "4, or 3 with check in 2nd season?"; "New or old growth on edge?"; "2* clear".

d. For spring collections, form an opinion about whether there is an unseen annulus on the edge and if there is new or old growth. Individual fish may differ, and young fish are more likely than old fish to show new growth on a given date. (Note: for unseen annuli on the edge of the scale, add a year and an asterisk; e.g., 3* indicates two visible annuli and a third will soon form on the edge).

e. Use fish length only as a rough indicator of age — much variation is possible. Often it is difficult to decide between two basic patterns: fast-grow with checks, or slow-grow without checks. Consider other sources of information, such as length-frequency peaks and history of the population.

6. On the second run through the scale envelopes, re-age consistent with the overview obtained from the first run.

7. For scales which cannot be aged with reasonable confidence:

   a. Clean, re-press, and examine again;

   b. Confirm by another reader;

   c. Discard from the analysis.

   However, avoid discarding all the odd samples that may, in reality, represent normal population variation.

8. If, finally, you are not reasonably confident about the ages, add a comment on the *Growth Analysis Form* stating that this sample was difficult to age. This may help others to properly interpret data on the form.

Some Aging Tips for Walleye and Yellow Perch

1. The first annulus may not demonstrate crossing over of circuli. The general pattern of circuli spacing is often a better indicator, but beware that variations in spacing may be caused by a change in diet, fall growth, or stocking.

2. The second, third, and fourth annuli usually show crossing over. A seasonal growth pattern is most likely to be seen in the second growing season. Sometimes seasonal growth is apparent in the first and third seasons. The classic pattern for circuli is wide spacing in late spring, narrow spacing in summer, and fairly wide spacing in fall. However, in many populations growth (and spacing) may be the highest in the fall, when forage such as young-of-year perch or shad become available.

3. Older annuli often do not show clear crossing over and a seasonal pattern to circuli spacing. Closely examine the diagonal anterior-lateral fields (1 to 2 o'clock and 10 to 11 o'clock as the scales are oriented with posterior "spiny" end down). Look for gaps or other irregularities in circuli spacing. Look also for blank strips where circuli have been absorbed due to poor nutrition. (But don't confuse absorption marks with artifacts caused by poor pressing). Usually assume there is one annulus per irregularity (sometimes there is more than one but that can only be surmised from known-age samples).

4. Write on the projection screen, directly on the projected image, with a non-permanent marker. Mark where annuli seem to be located; see if the pattern and count on one side of the scale match that on the other side; trace the annuli all the way around the scale; see if other scales from the same fish match up with these marks.

Some Aging Tips for Northern Pike (Williams 1955)

1. The readability of pike scales varies by body location (Figure 1). Scales obtained from the middle of pike are the easiest to age, as is generally true of walleye and yellow perch.

2. The first annulus is usually unique in that the extremely rapid growth following it is

characterized by irregular or incomplete circuli, often chain-like in pattern with wide spacing. It may occasionally be represented by a simple change in growth rate from slow to more rapid. The first annulus may also consist of several close, irregular or discontinuous circuli following the fall growth and preceding the spring growth. It is seldom represented by a hyaline area (white line or blank stripe) on the scale.

3. The second annulus is usually indicated by several close, discontinuous circuli. It may be indicated by a white line at the lateral region, but is seldom indicated by the chain-like pattern of the first annulus.

4. Annuli of the third and later years are usually represented by a white line "cutting over" circuli at the anterolateral and posterolateral regions. More typically, it may also be indicated by several close, irregular circuli between narrow (fall) and wide (spring) circuli.

5. Annuli of all years have a strong tendency to show as hyaline, unmarked areas in the posterior field of the scale.

6. Pike of age-group 1 (and to some extent age-group 2) will often form the annulus before spawning, but later age groups form the annuli a month or more after younger fish. The time of annulus formation ranges from early March - June 1 in the southern latitude of Michigan to late March - late June in the middle and northern latitudes.

7. One- and two-year-old pike in study lakes in the northern part of the Lower Peninsula of Michigan completed roughly 50% of their annual scale growth by July 1, 75% by August 1, and 95 to 100% by October.

8. Pike of age-groups 1 and 2 in Sugarloaf Lake (southern Michigan) completed approximately 91 to 96% of the entire year's scale growth by October.

9. Growth in body length from October to March is relatively greater than growth of the scales. Overwinter length rarely increases by more than 1 in.

10. Many pike, after the first year of life, form definite false annuli on their scales during midsummer. This mark, which may show as a distinct white line, is apparently caused by a growth cessation during July or August and is probably associated with high summer water temperatures. The mark is sometimes replaced wholly or in part by close circuli during the midsummer period. Rarely is the growth rate more than slightly retarded during midsummer of the first year. A false annulus appears on the scales of some pike and not of others in the same season and in the same lake. It may be formed each year on the scales of individuals from some lakes, but pike from various other lakes seldom show evidence of it.

11. Whereas the false annulus cannot often be identified by the appearance of its circuli, an important characteristic of fall scale growth is of great assistance. Late summer or fall growth, after the formation of the false annulus, results in many circuli ending at the margin of the scale between the anterolateral and the posterior regions. Growth of the scale is considerably less, therefore, at the posterior than at the anterior part. There are usually more than twice as many circuli anterolaterally as posterolaterally after the false annulus. After the true annulus, however, there are usually less than twice as many circuli at the anterolateral as the posterolateral region. The result of this is that a false annulus may be 6 or 8 circuli in from the margin at the anterior region of the scale but run off the margin before the posterior region is reached. If a true annulus is 6 or 8 circuli in from anterior margin, it will be 4 to 6 circuli in from the posterior margin.

12. A very abrupt change in growth rate occurring in early summer of the first year may sometimes take the appearance of an annulus near the focus of the scale. It is thought that a change in feeding habits, from insects to fish, might be the cause.

13. Spawning checks form occasionally on pike scales if the annulus is formed before

spawning. Several extremely close, regular or irregular circuli usually mark the spawning period. In most cases, however, it is incorporated with the year mark.

14. Tagging with a tag on the lower jaw of pike is definitely detrimental to both growth rate and condition of the fish.

Known-age Scale Samples

Microfiche photographs of known-age walleye (Figures 2-25), yellow perch (Figures 26-41), and northern pike (Figures 42-59) are appended. Unfortunately, these photographs are not as easy to interpret as the original plastic impressions due to loss of clarity in the duplication process and because a better mental image can be formed by examining several scales from each fish rather than only one scale (albeit the best one). Many of these examples are difficult to age; some are impossible! They have been selected to illustrate a variety of scale patterns. Hopefully, scales from most populations will not be as difficult as these.

For walleye and yellow perch, figures are paired with a photograph and basic data on the right-hand page, and the same photograph with my interpretation on the back of the page. For some fish, the total age of each fish is known, it was not always possible to mark the exact location of each annulus or to discern annuli from checks.

For northern pike, Williams (1955) provided the information and interpretation for each figure duplicated here.

The Serious Student Should Take This Approach for Walleye and Yellow Perch

1. Make paper copies of each figure. Attempt to age each scale with an open mind using the information on fish length, collection date, and site (if that's any help-- see site descriptions below). Freely make pencil marks on your paper copy: trace circuli, mark possible location of checks and annuli, etc.
2. Re-age each figure a second time (to benefit from experience gained by seeing the whole set).
3. Carefully compare your results to the answers and interpretations on the paired right-hand figures.

About the Primary Collection Sites for Known-age Scales

Jewett Lake – A very small, shallow, lake in Ogemaw County which as been experimentally manipulated and intensively sampled for many years. Yellow perch of known age were stocked in certain early years and native year classes were produced. Later, fin-clipped fingerling walleye were stocked in certain years. Eventually, natural reproduction by both species created stable populations. Many walleye were marked with Floy anchor tags as subadults. Bluegill also became established in the lake.

Manistee Lake – A large, shallow lake in Kalkaska County that had a good self-sustaining walleye population for many years. After natural reproduction failed, fin-clipped fingerling walleyes were stocked. Yellow perch, white sucker, and a typical mixture of warmwater species are present.

Muskegon River – A spawning run occurs at Croton that is made up of walleyes from Lake Michigan, Muskegon Lake, upstream impoundments, and the river itself. Fin-clipped fingerling walleye were stocked in certain years.

Lake St. Clair – This small Great Lake contains good native populations of walleye, yellow perch, and other species. In an attempt to establish a walleye spawning run in the Clinton River, fingerling walleye were reared in a pond to 7-10 inches (October, age 0), jaw tagged and released. Some were recaptured.

Saginaw Bay – This large bay of Lake Huron has a long history of slow-growing yellow perch, which are difficult to age.

Cassidy Lake – A 42-acre, shallow lake in Washtenaw County that was treated with rotenone and experimentally stocked with

yellow perch. The population was monitored for 5 years.

Saline Ponds – Productive, 0.5-acre ponds which were experimentally stocked with walleye fry, or yellow perch eggs or fingerlings in certain years.

Blueberry Lake – A 20-acre lake in Livingston County containing excellent populations of warmwater fishes, including yellow perch. The perch are not of known age, but the samples shown here are believed to be reliable because the population was intensively monitored for 6 years. These scales were included because their patterns are typical of some other perch populations.

Sugarloaf Lake – A shallow 180-acre lake in Washtenaw County containing a typical warmwater fish community including a modest northern pike population. Young pike, 16-25 mm total length, were captured in a weir on the inlet stream and moved to the Drayton Plains Hatchery pond for rearing. Later, some fingerling pike marked with tags or fin clips were returned to Sugarloaf Lake and recaptured at a later date.

Drayton Plains Hatchery Pond – A 0.63 acre pond in Oakland County with a maximum depth of 5 feet. It contained only stocked pike and forage fish during a growth study from 1950 to 1953.

Walsh Lake – A 10-acre lake in Washtenaw County, without native pike, where fingerling pike were introduced and recaptured at a later date.

References

Schneider, J.C., P.W. Laarman, and H. Gowing. 2000. Age and growth methods and state averages. Chapter 9 in Schneider, James C. (ed.) 2000. Manual of fisheries survey methods II: with periodic updates. Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor.

Summerfelt, R.C., and G.E. Hall, editors. 1987. Age and growth of fish. Iowa State University Press, Ames.

Williams, J.E. 1955. Determination of age from the scales of northern pike (*Esox lucius L.*). Michigan Department of Conservation, Fisheries Research Report 1449, Ann Arbor.

James S. Diana, Editor
Alan D. Sutton, Graphics
Barbara A. Diana, Word Processor
Deborah L. MacConnell, Desktop Publishing

Approved by Paul W. Seelbach

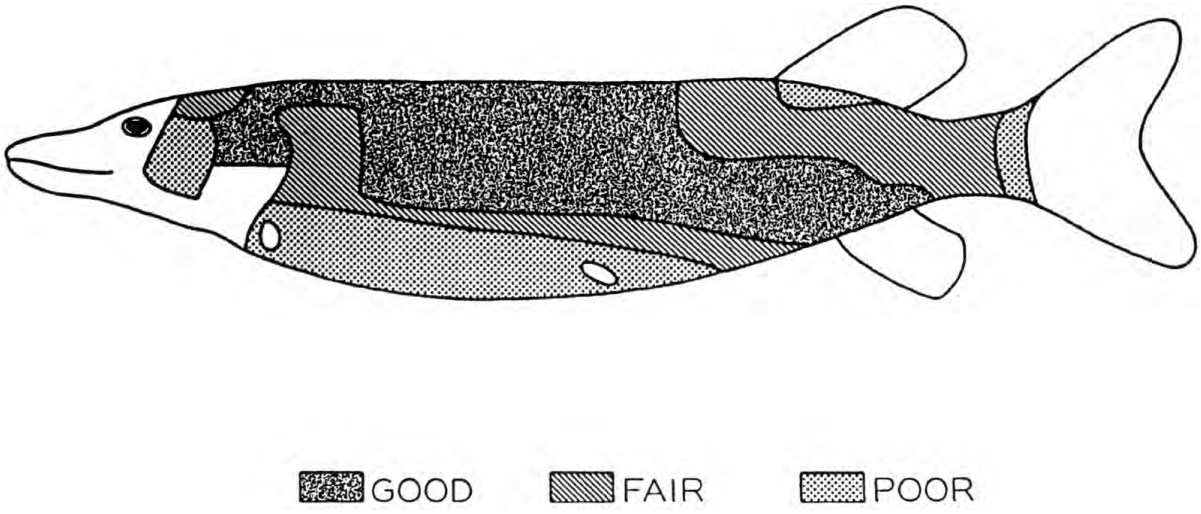


Figure 1.–Relative readability of scales from various regions of a northern pike. (Figure 9 of Williams 1955)

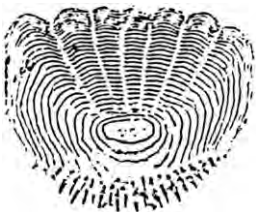


Figure 2a.–Walleye; 3.5"; December 1991; Saline Pond; 27X.

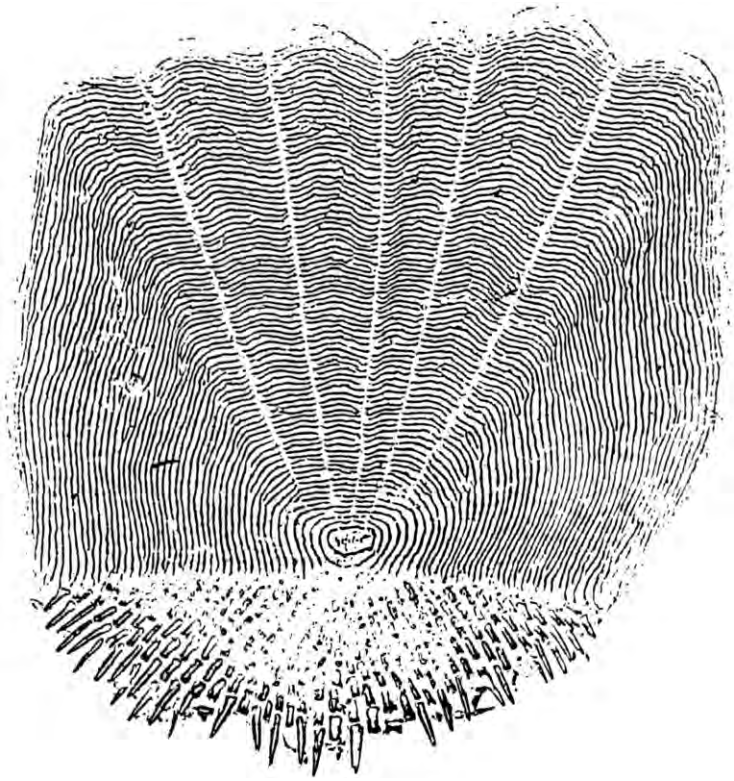


Figure 2b.–Walleye; 9.2"; October 1979; Jewett Lake; 27X.

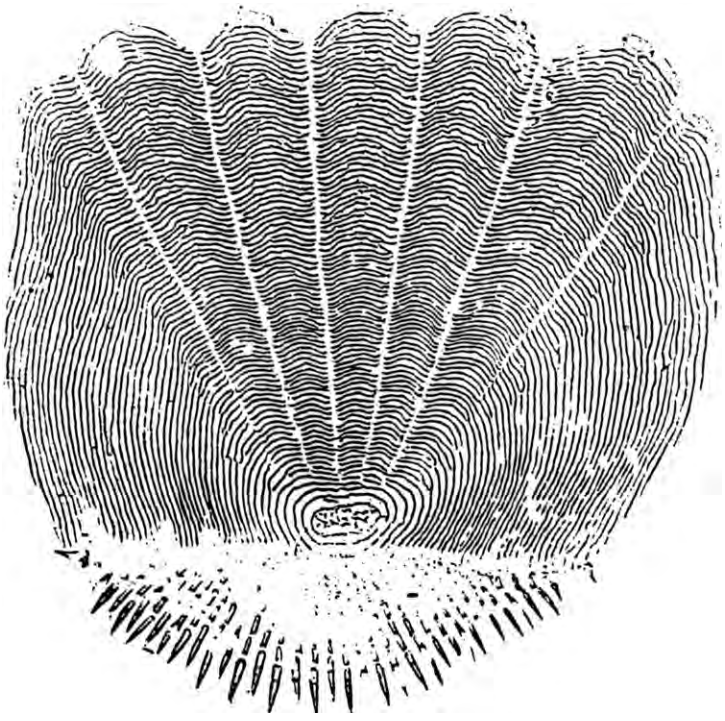
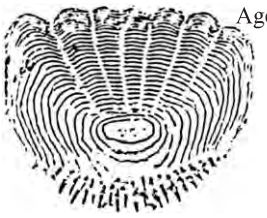
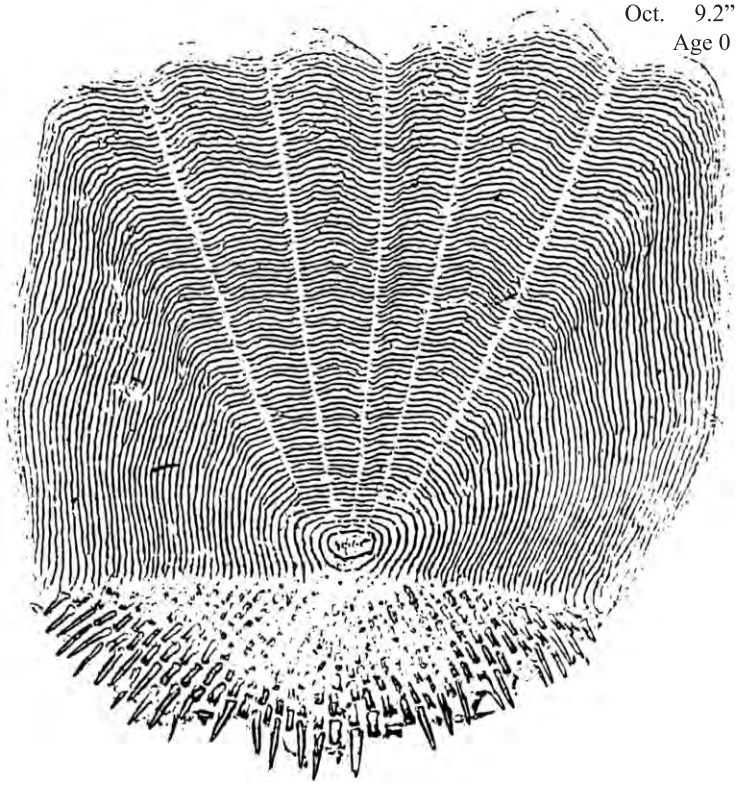


Figure 2c.–Walleye; 8.7"; October 1991; Jewett Lake; 27X.



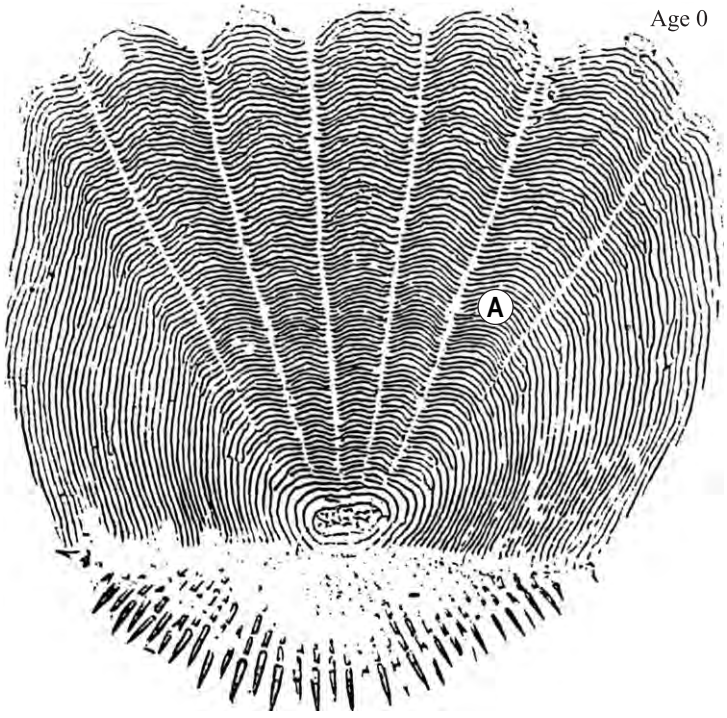
Age 0 Dec. 3.5”

Figure 2a.–Age 0 walleye. Stocked into a pond as fry. Relatively slow growth due to high density. Note slow growth in the fall instead of the usual fast growth.



Oct. 9.2”
Age 0

Figure 2b.–Age 0 walleye. A fast-growing Jewett Lake native. As easy as it looks, if not deceived by size



Age 0 Oct. 8.7”

Figure 2c.–Age 0 walleye. A fast-growing native from Jewett Lake. Note increased spacing between circuli after the middle of year (“A”), increased growth, but no crossing over. Other scales from this fish show a more or less pronounced check. See also Figures 10a and 10b.

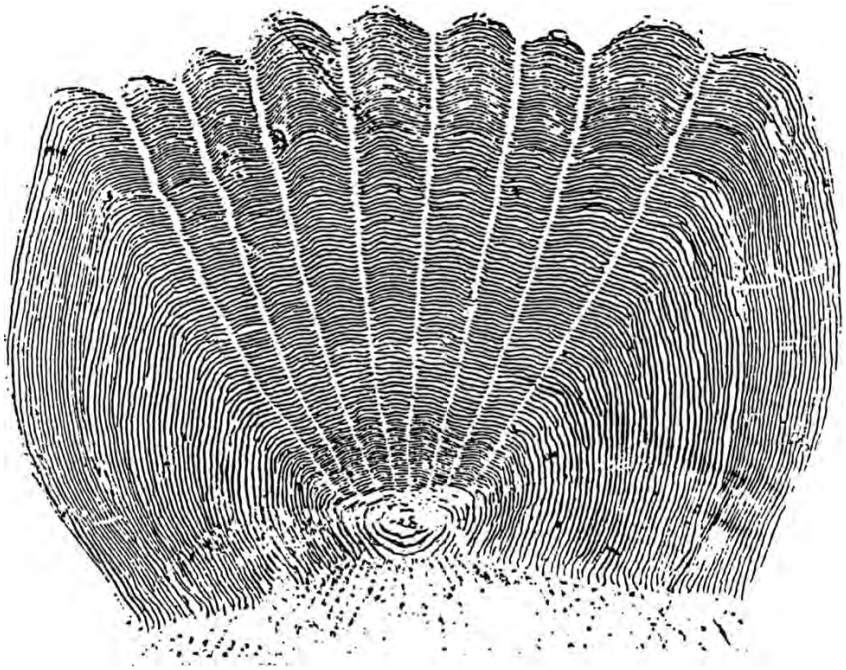


Figure 3a.–Walleye; 13.2”; October 1981; Jewett Lake; 27X.

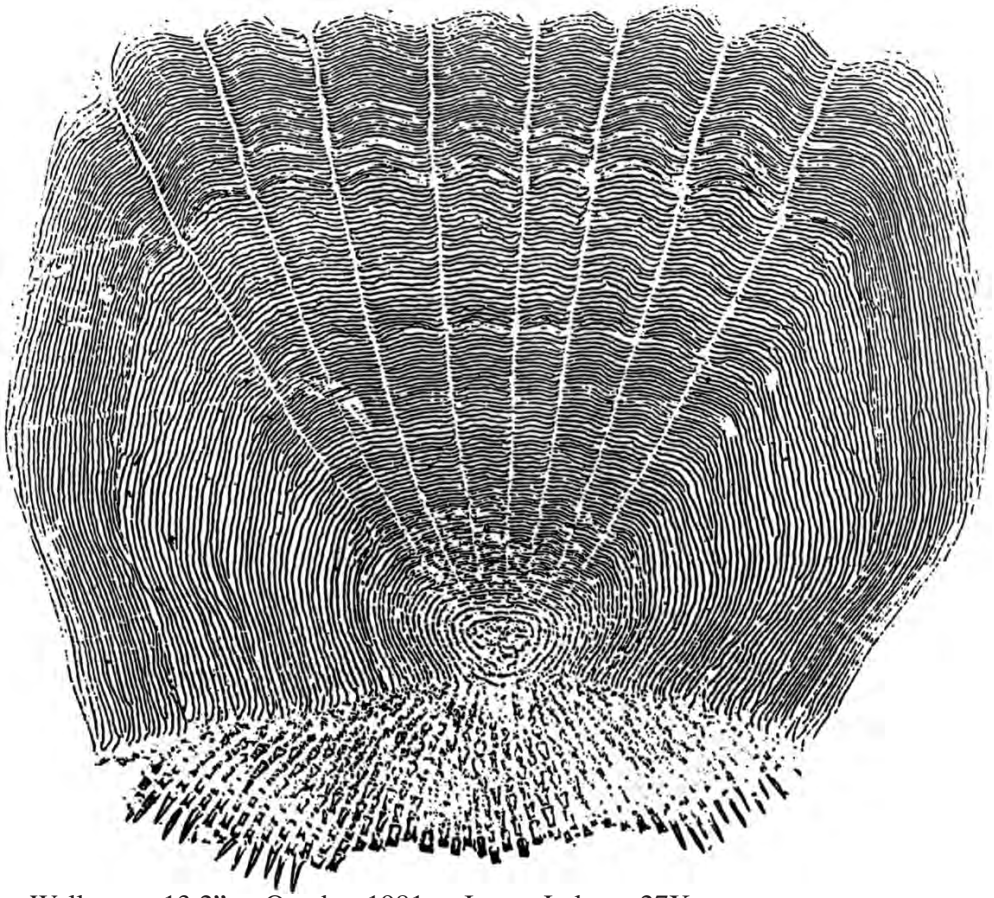


Figure 3b.–Walleye; 13.2”; October 1981; Jewett Lake; 27X.

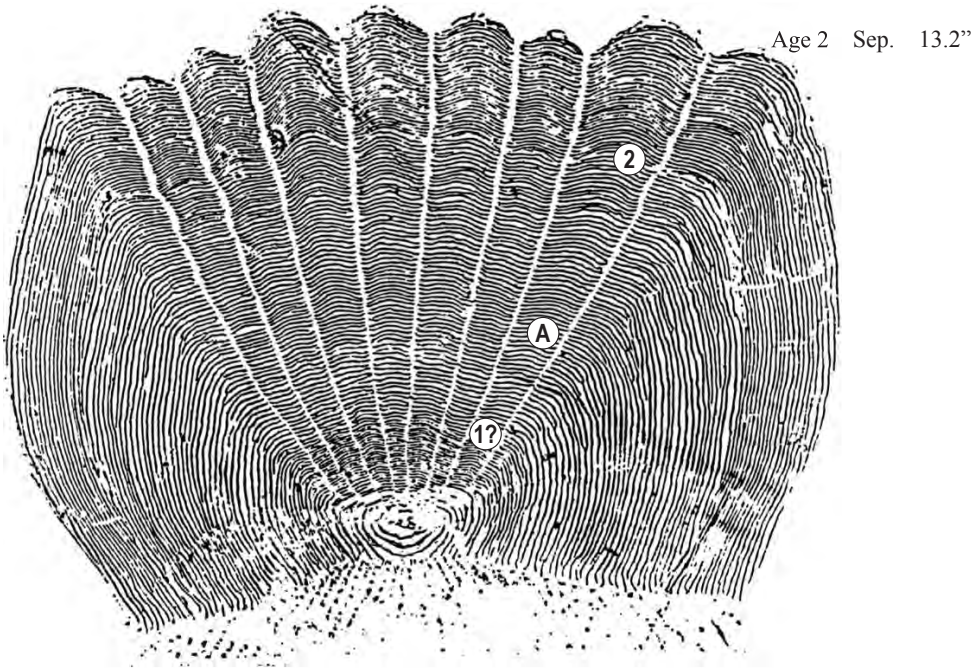


Figure 3a.–Age 2 walleye. Stocked in Jewett Lake in September 1979 with RP fin clip. Stocked walleye averaged 4.2 in, but the exact size of this fish then is unknown. The first annulus is probably located where indicated, but somewhere around “A” is a remote possibility.

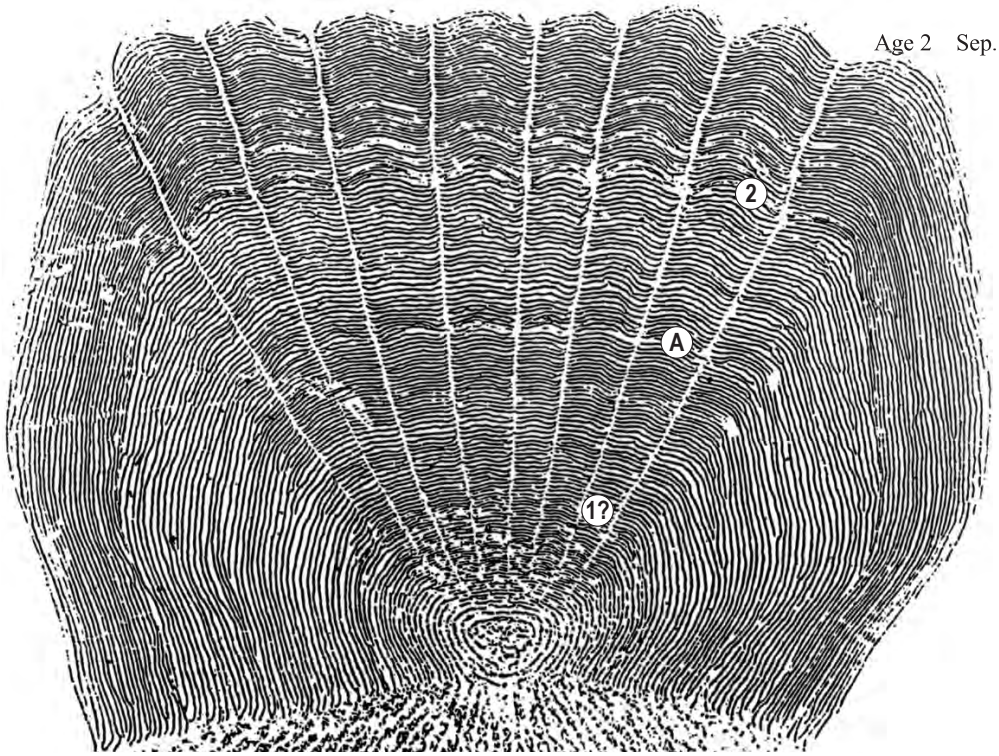


Figure 3b.–Age 2 walleye. Could have easily been mis-aged as 3. Same clip and history as Figure 3a. The location of the first annulus is more questionable for this fish, and it could be at “A”. Arguments favoring site “1?” are:

a. Other scales from this fish (not shown) show less distinct crossing over at “A”;
b. Other fish of about the same size/age show relatively fast growth and a tendency to check during the second season (see Figures 3a, 4, 5);
c. The RP fish were, on average, small at stocking.

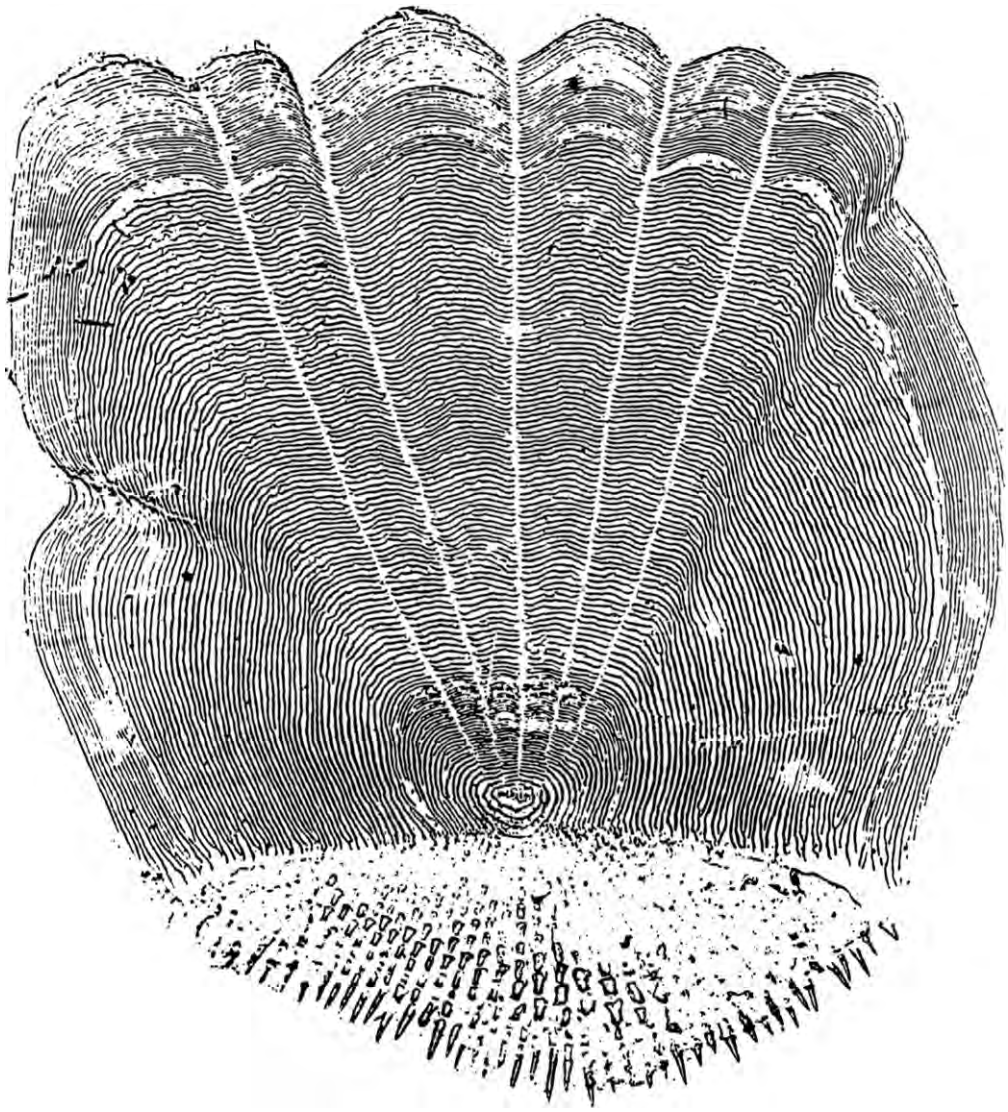


Figure 4.–Walleye; 13.7"; September 1981; Jewett Lake; 27X.

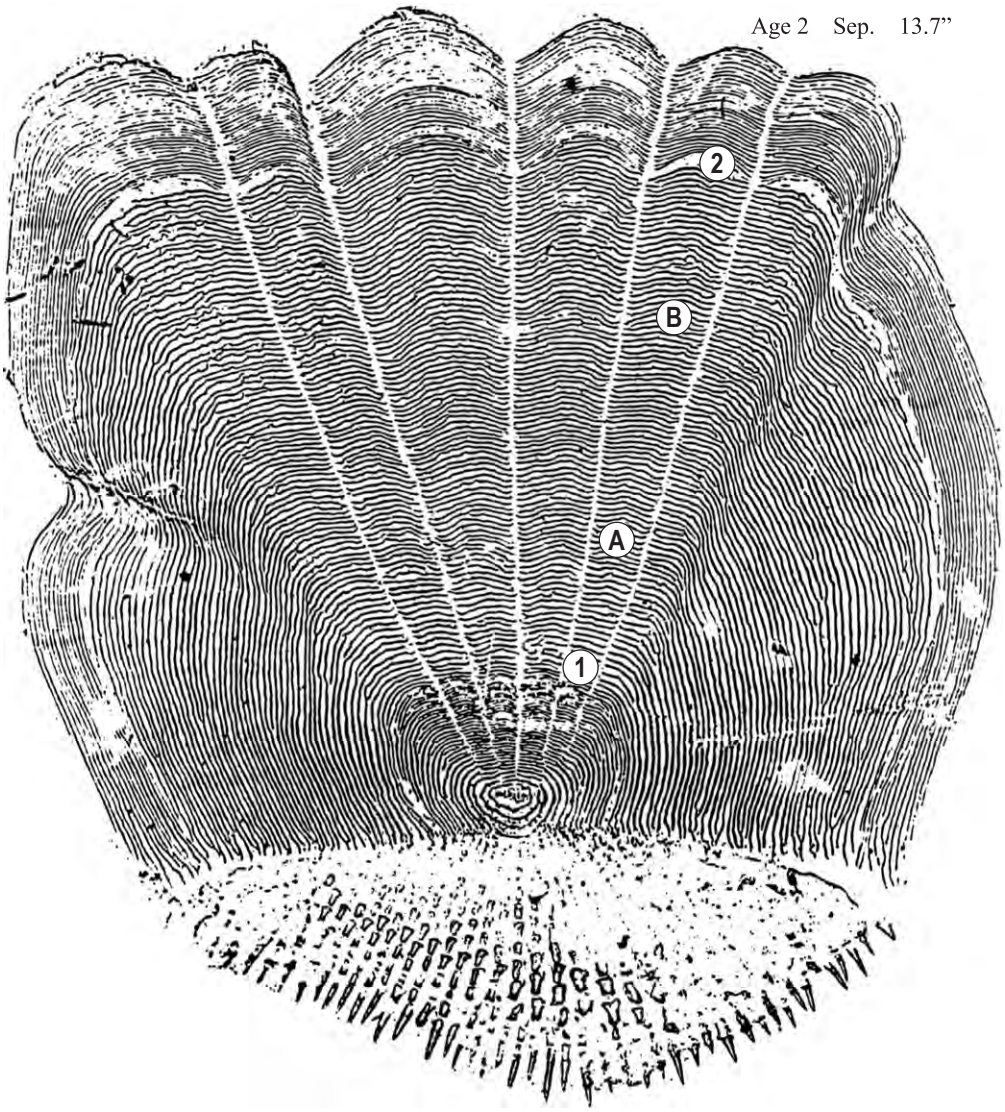


Figure 4.–Age 2 walleye. Same RP (1979) fin clip as Jewett Lake walleyes in Figures 3a and b. This fish was previously captured in September 1980 when 11.9 in long and had been marked with tag no. 4232. Location of the first annulus seems to be at “1”, but “A” is a remote possibility given the very accelerated growth which follows and the tendency for some fish in this population to spurt in the fall (see Figures 5, 12, 13). Note spurt of growth at “B”, in late summer 1980, probably due increased availability of forage.

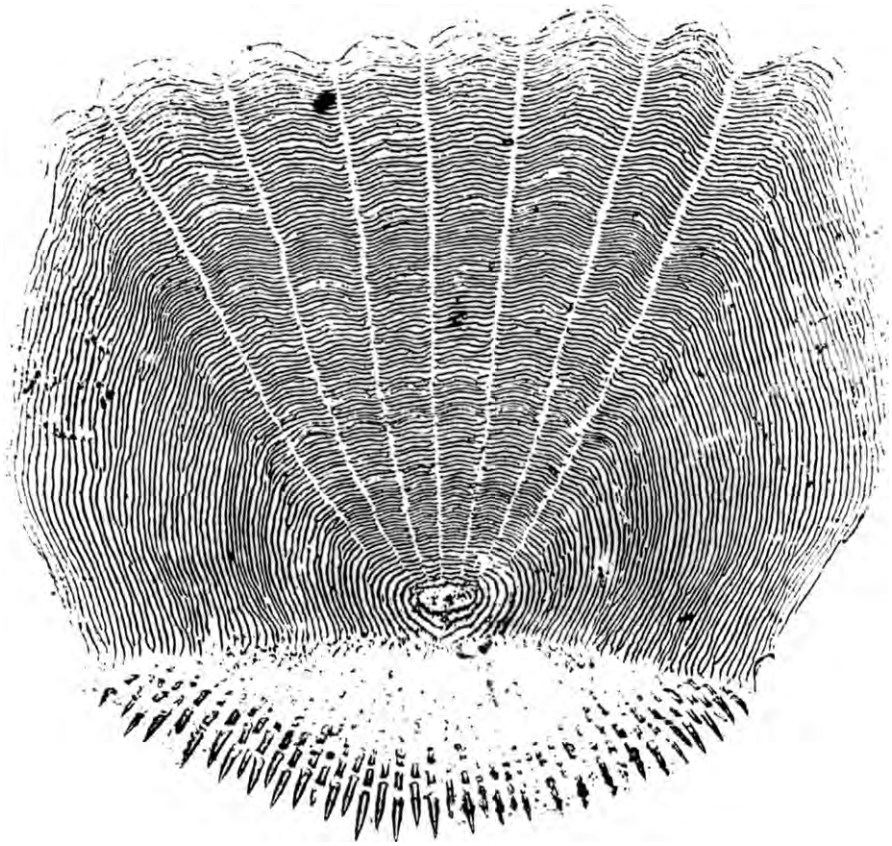


Figure 5.–Walleye; 11.8”; September 1980; Jewett Lake; 27X.

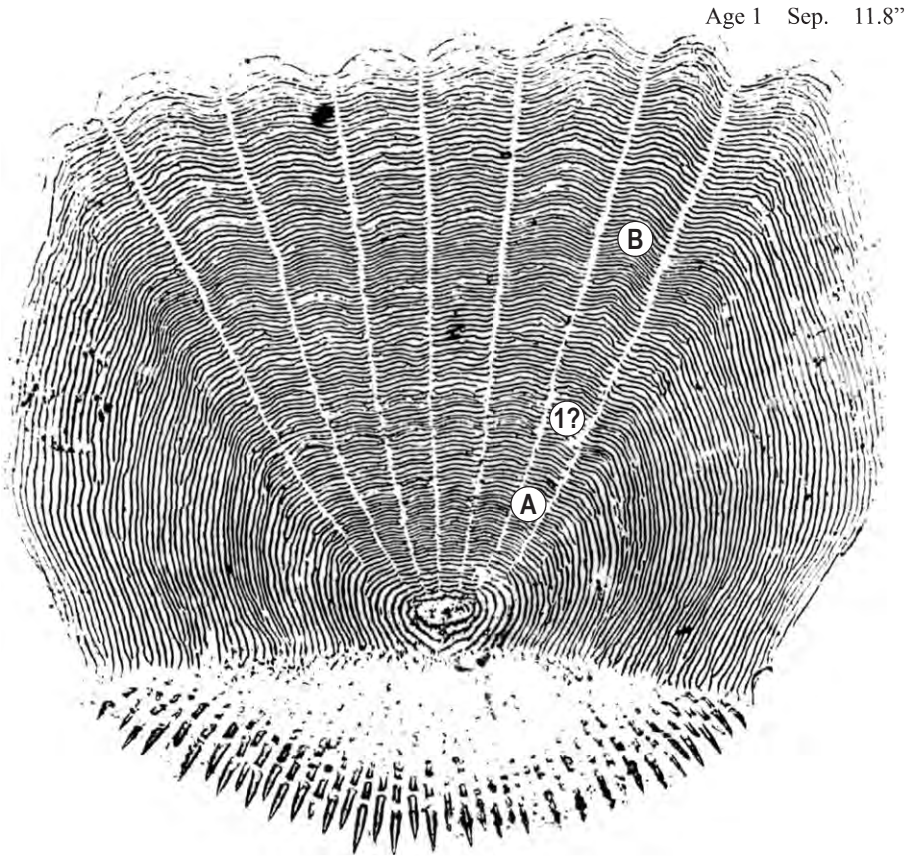


Figure 5.–Age 1 walleye. Another Jewett Lake walleye with RP (1979) planting clip. It was given tag no. 04271 when the scale sample was taken. Location of first annulus probably at “1” because of crossing over, but “A” cannot be ruled out. Summer slowdown gives check-like look to “B”. Thus, the pattern appears to be spurts of growth in fall of the first year and in spring and fall of the second year, and checks after planting and in the middle of the second year

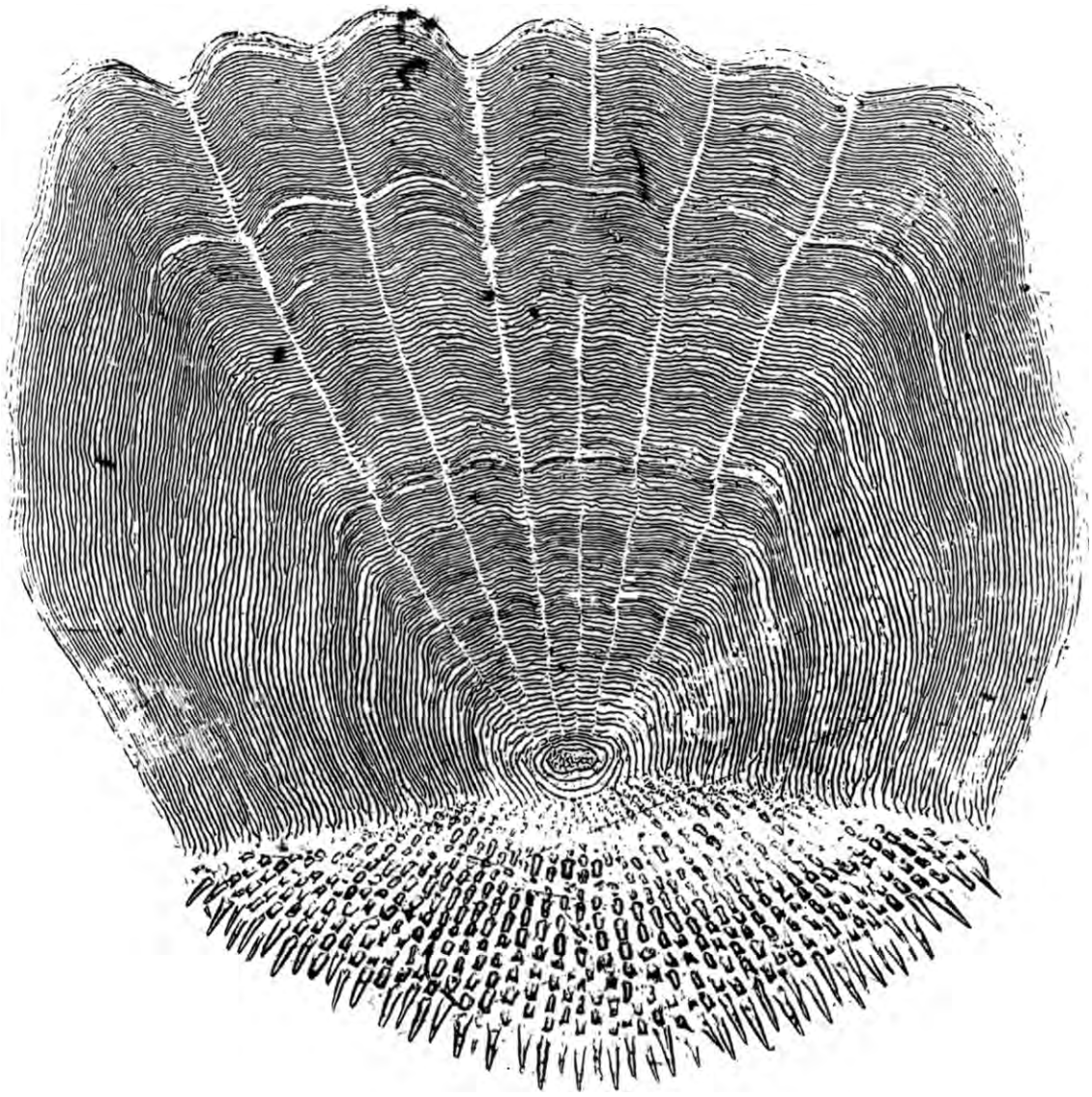


Figure 6.–Walleye; 13.0”; September 1979; Jewett Lake; 27X.

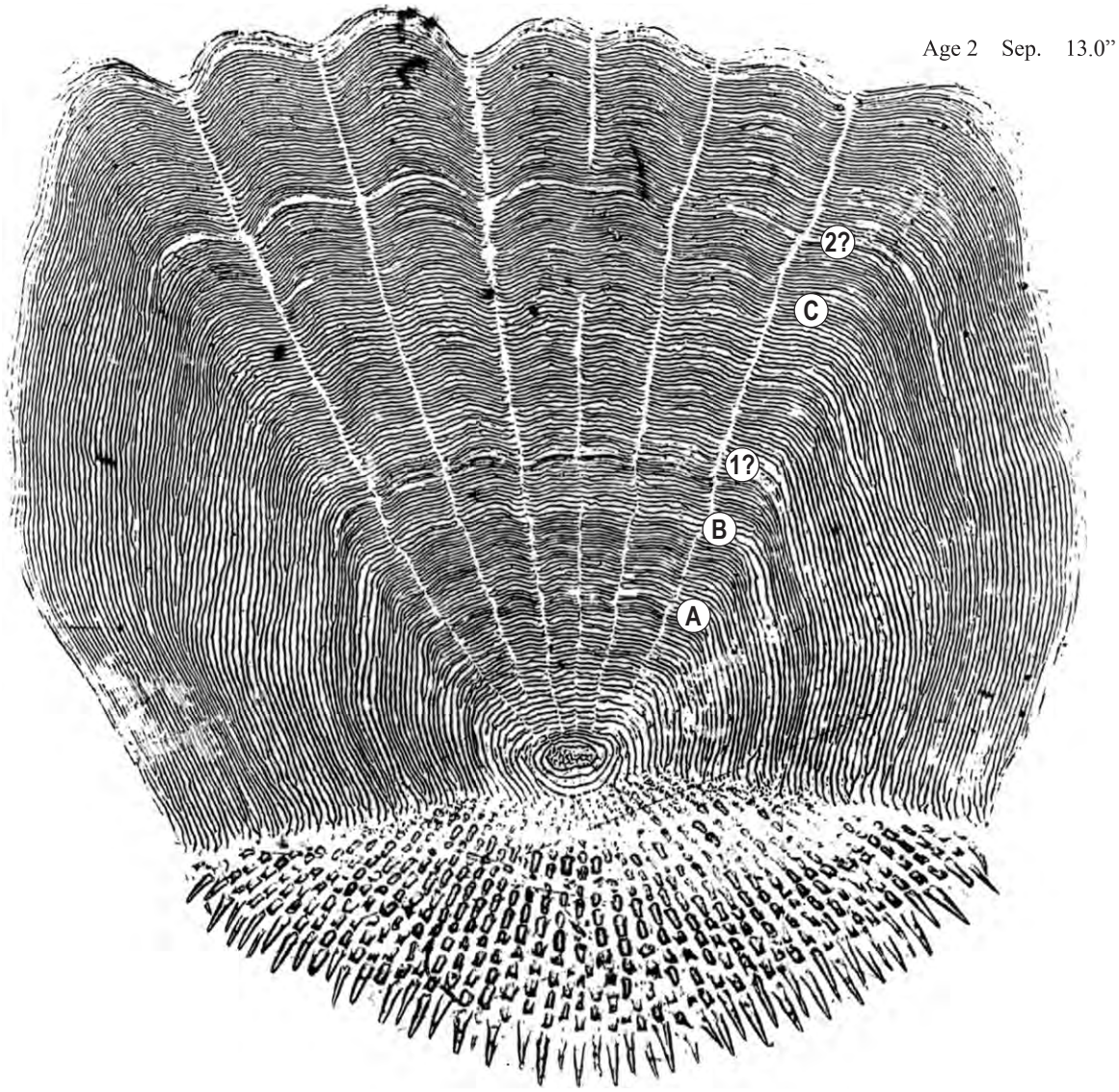


Figure 6.–Age 2 walleye. This walleye had a LP (1977) clip when stocked in Jewett Lake. It was given tag no. 04170 when the scale sample was taken. Most agers would recognize this as probably age 2 (in part because it was only 13 in and the growth of other fish in this collection is OK). However, this scale is difficult to interpret because it contains three checks and it is hard to pinpoint the exact location of the annuli. The first annulus could be at either “1?”, “A”, or “B”, but “1?” is favored because it has cutting over; thus “A” is probably a rearing pond check and “B” was probably caused by stocking in the food-rich lake. In addition, LP fish averaged 5.4 in when stocked, which more likely corresponds to “B” than to “A”. The second annulus is probably at “2?” because of the wide gap in circuli; however “C” is also a strong possibility because it also shows some crossing over.

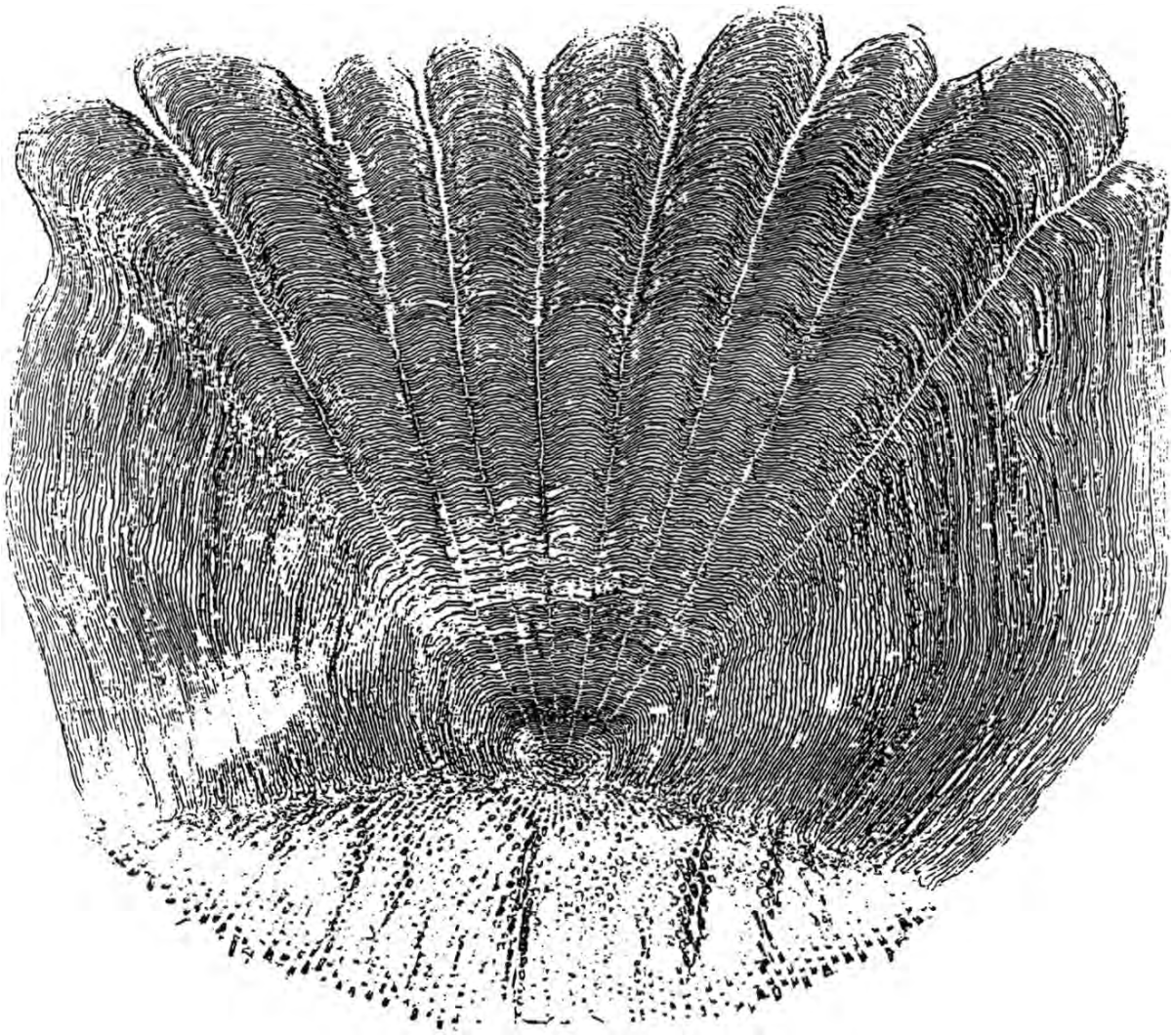


Figure 7.–Walleye; 22.0”; October 1979; Jewett Lake; 19X.

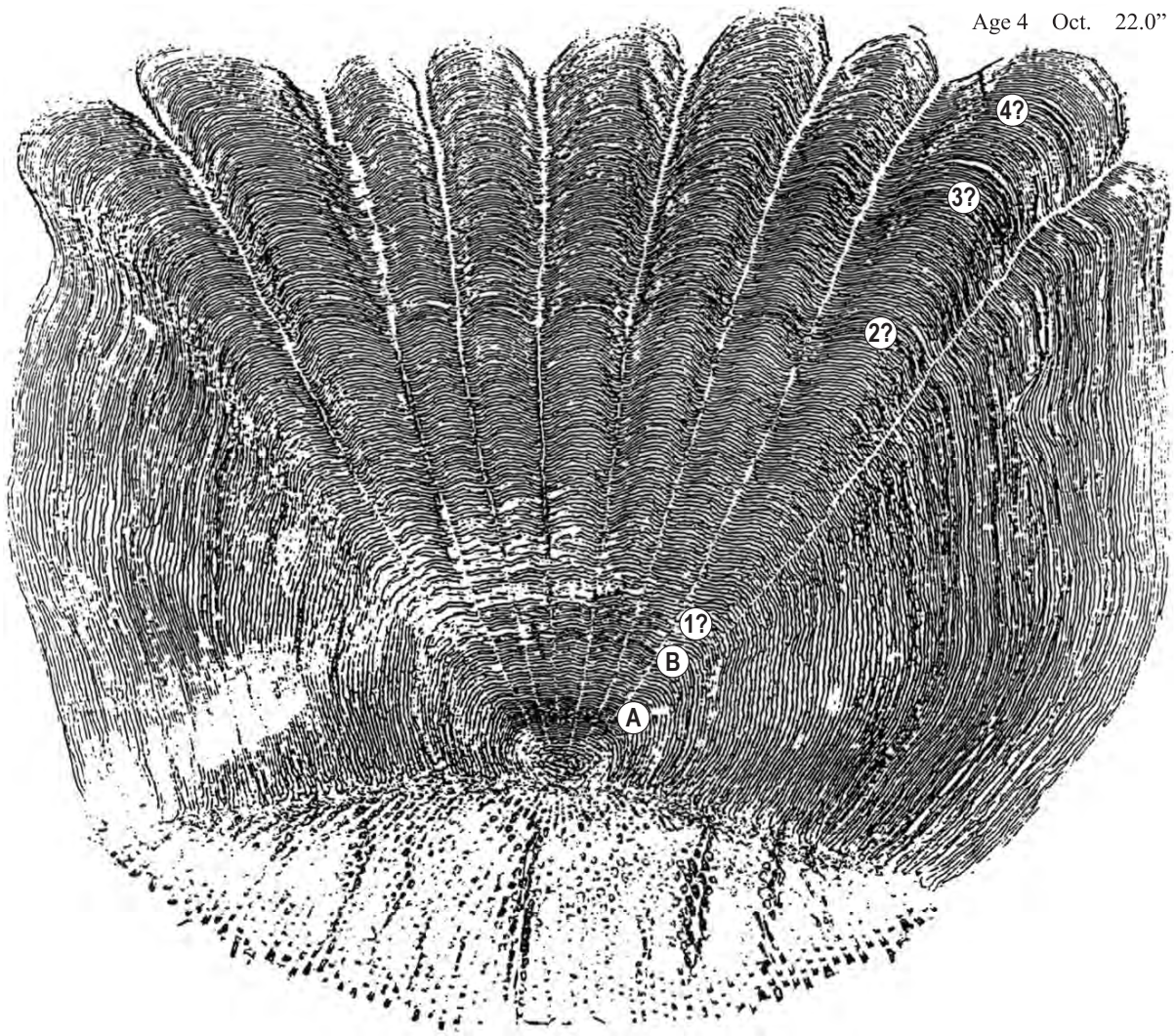


Figure 7.–Age 4 walleye. Stocked into Jewett Lake with RV clip (1975). It was issued tag no. 04187 when the scale sample was taken. Likely locations of the four annuli are marked. Growth was rapid because Jewett Lake contained no walleyes prior to 1975 and forage was very abundant. Stocked RV walleyes averaged 5.6 in. The check at “A” probably occurred during pond rearing, and the check at “B” probably reflects the transition to lake life in fall 1975. A fall spurt in growth is not evident in other years.

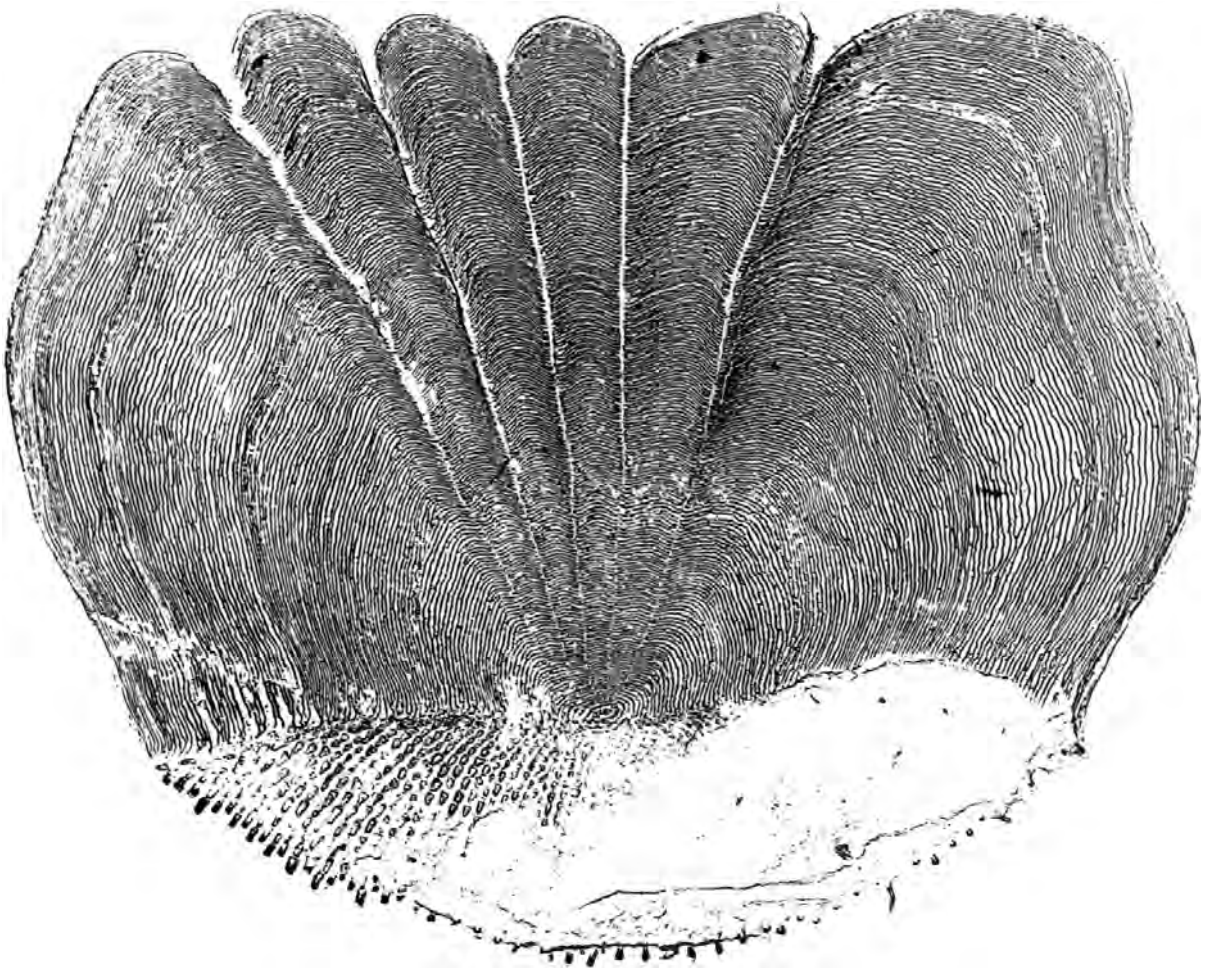


Figure 8.–Walleye; 20.8”; female; April 1976; Muskegon River at Croton; 20X.

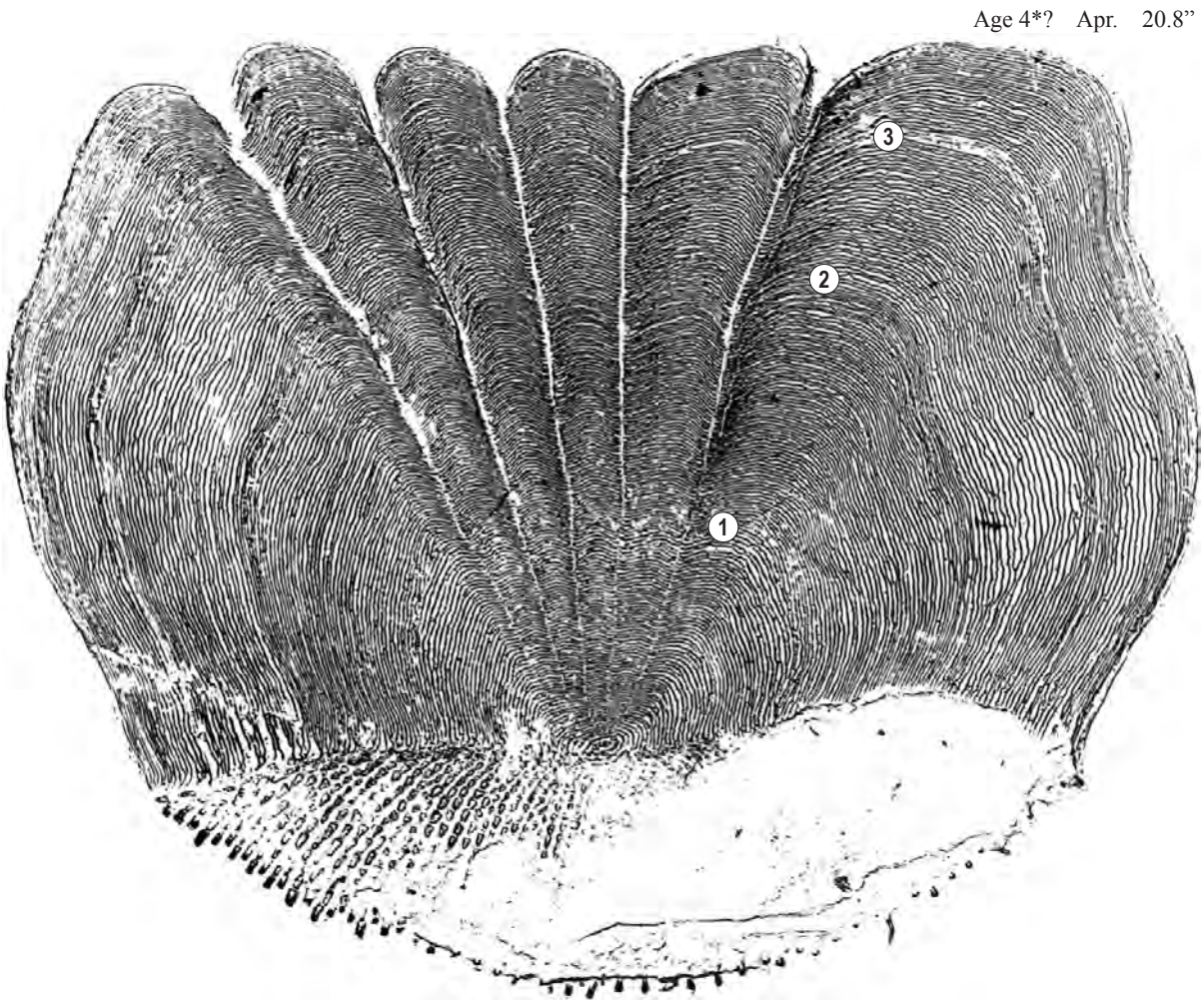


Figure 8.–This Muskegon River walleye is probably age 4* (three visible annuli and one is due to form on the edge as soon as growth begins). Age is not definitely known, but scale and dorsal spine samples were clear and agree. There is a hint of another possible annulus near the edge because the circuli pattern is fuzzy at 2 and 10 o’clock (possible resorption). However, there are no corresponding irregularities between 11 and 1 o’clock, and the impressions of other scales from this fish were not as fuzzy near the edge as this one. The rapid growth of this wild female is plausible because she had access to the forage-rich lakes (Muskegon and Michigan) and walleye population density was very low in the 1970s.

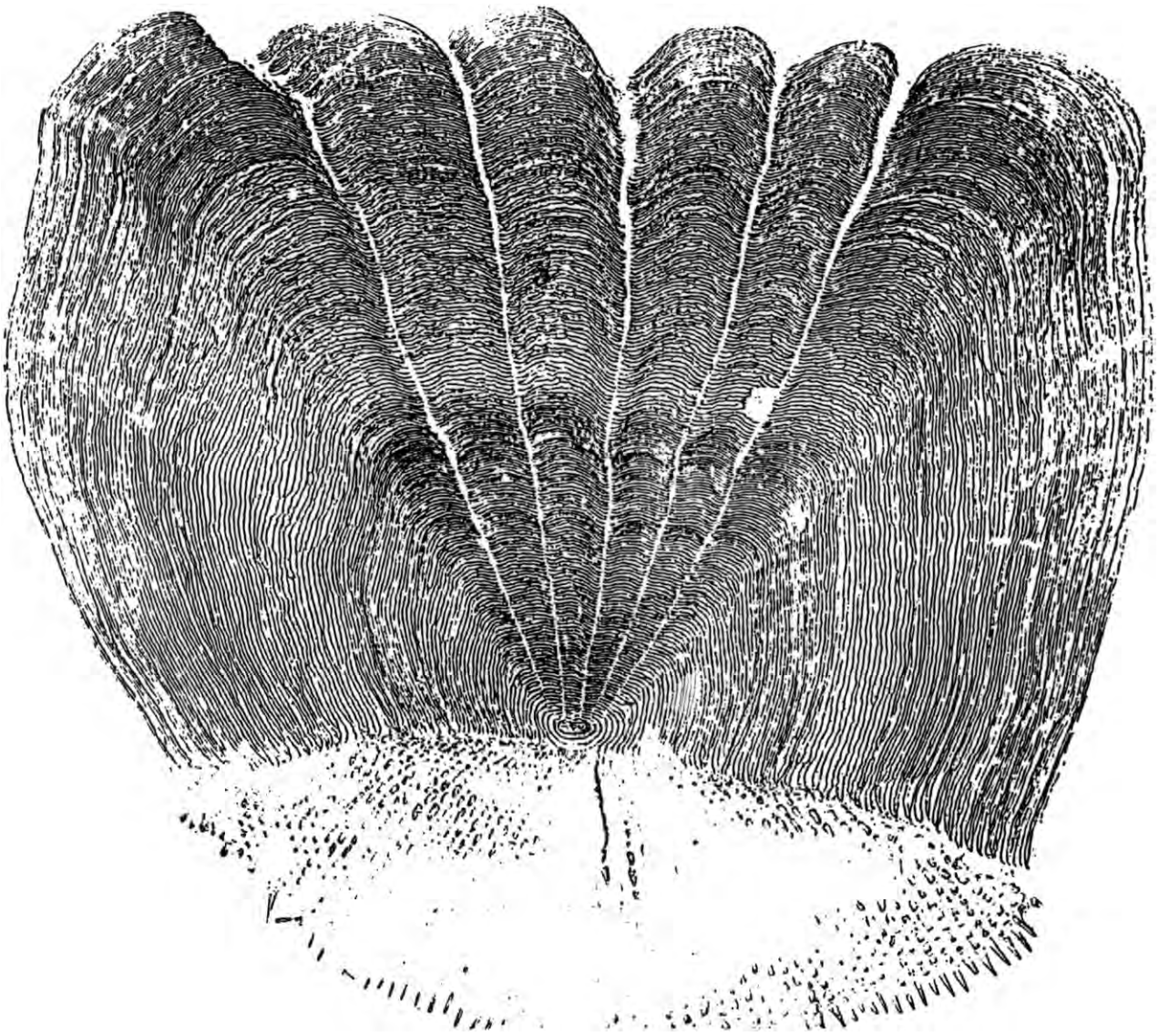


Figure 9.–Walleye; 20”; male; April 1982; Muskegon River at Croton; 20X.

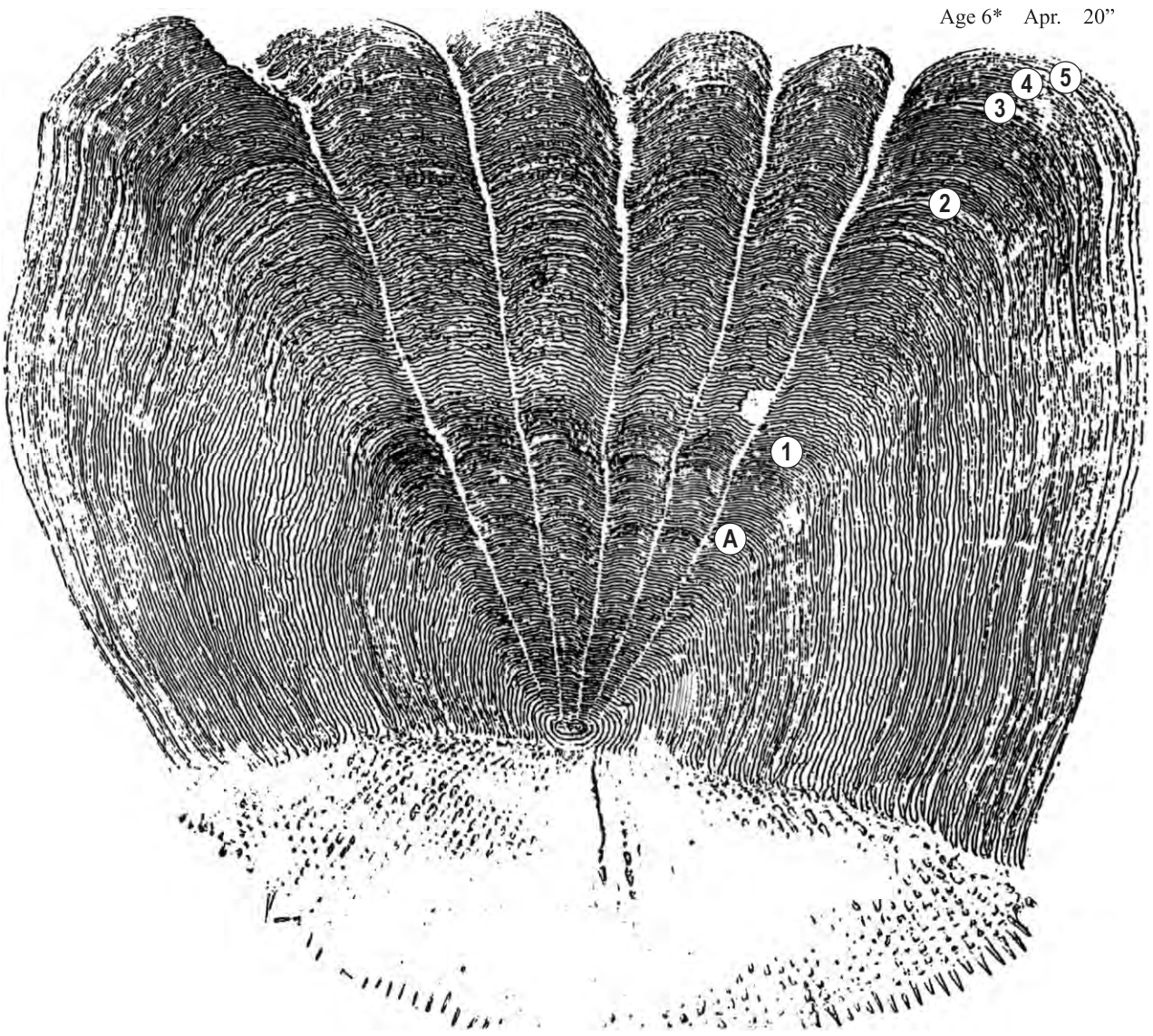


Figure 9.–Age 6* walleye. This Muskegon River spawner had a RP fin clip, indicating it was stocked as a fingerling in the Grand River in 1976. The most likely locations of the annuli are shown, and “A” is apparently a strong check associated with stocking. (The check showed less crossing over on some of the other scales). Since some river-dwelling walleyes grow slowly until they drop down into the Great Lakes, this check could have easily been interpreted as the first annulus. An alternative interpretation is that “A” is the first annulus and “5” is the check.

Figure 10a.–Walleye; 7.7”; September 1977; Manistee Lake; 20X.

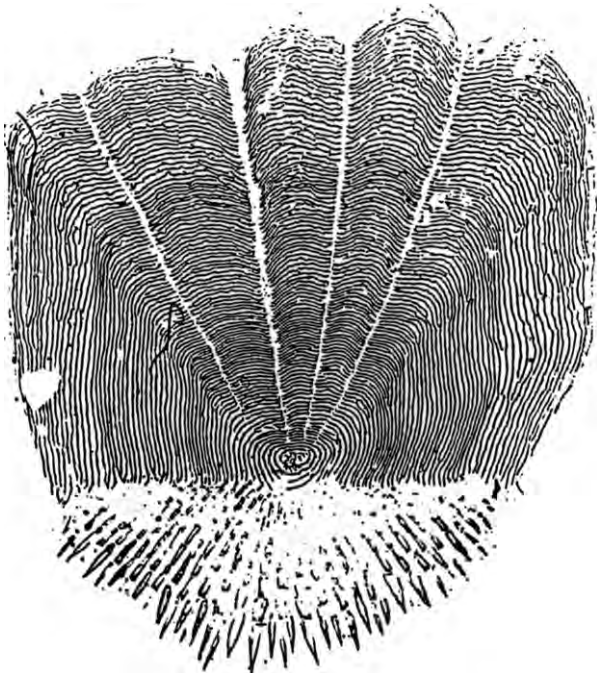


Figure 10b.–Walleye; 9.5”; September 1977; Manistee Lake; 20X.

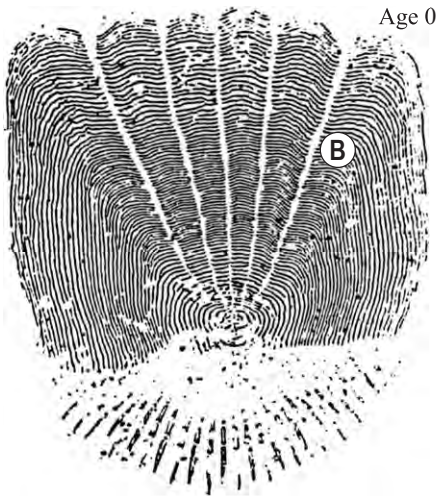


Figure 10a.–Age 0 walleye. Stocked in Manistee Lake with RP clip (1977). RP walleye averaged 5.3 in when stocked in early fall and some survivors had shown appreciable growth in both scale and body length by October 1. By that date, the average length of survivors large enough to be caught in trap nets was 8.6 in. Note the spurt of growth following stocking at “B”.

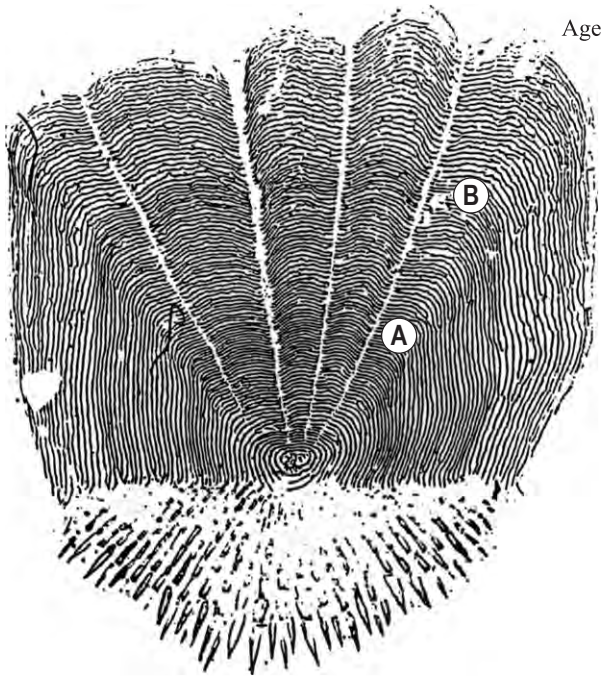


Figure 10b.–Age 0 walleye. RP clip with same history as 10a. Pond check apparent at “A”, and growth spurt following stocking begins at “B”. Without knowing collection date, could have been mistaken for age 1 collected in midsummer.

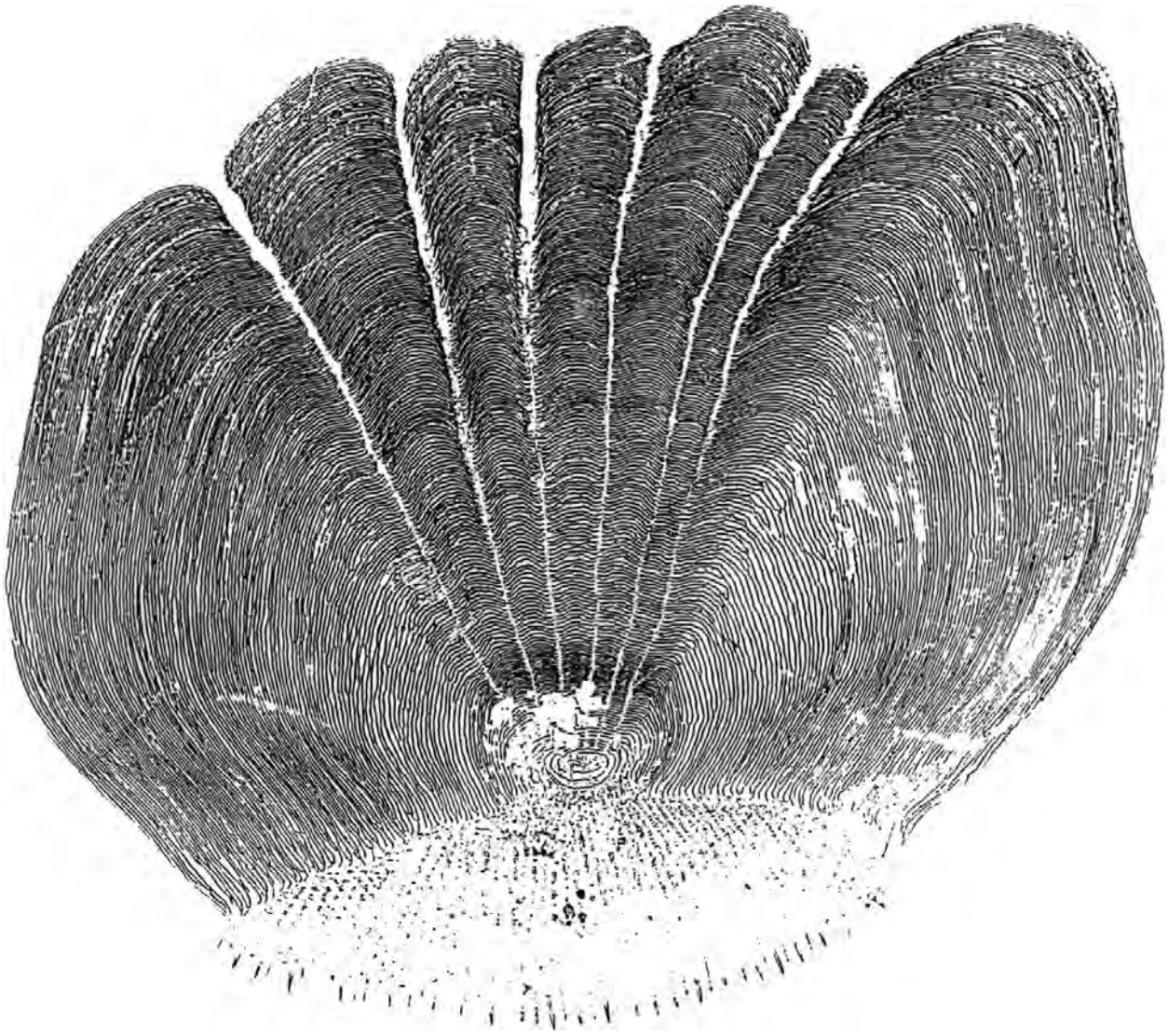


Figure 11.–Walleye; 21.6”; October 1984; Manistee Lake; 20X.

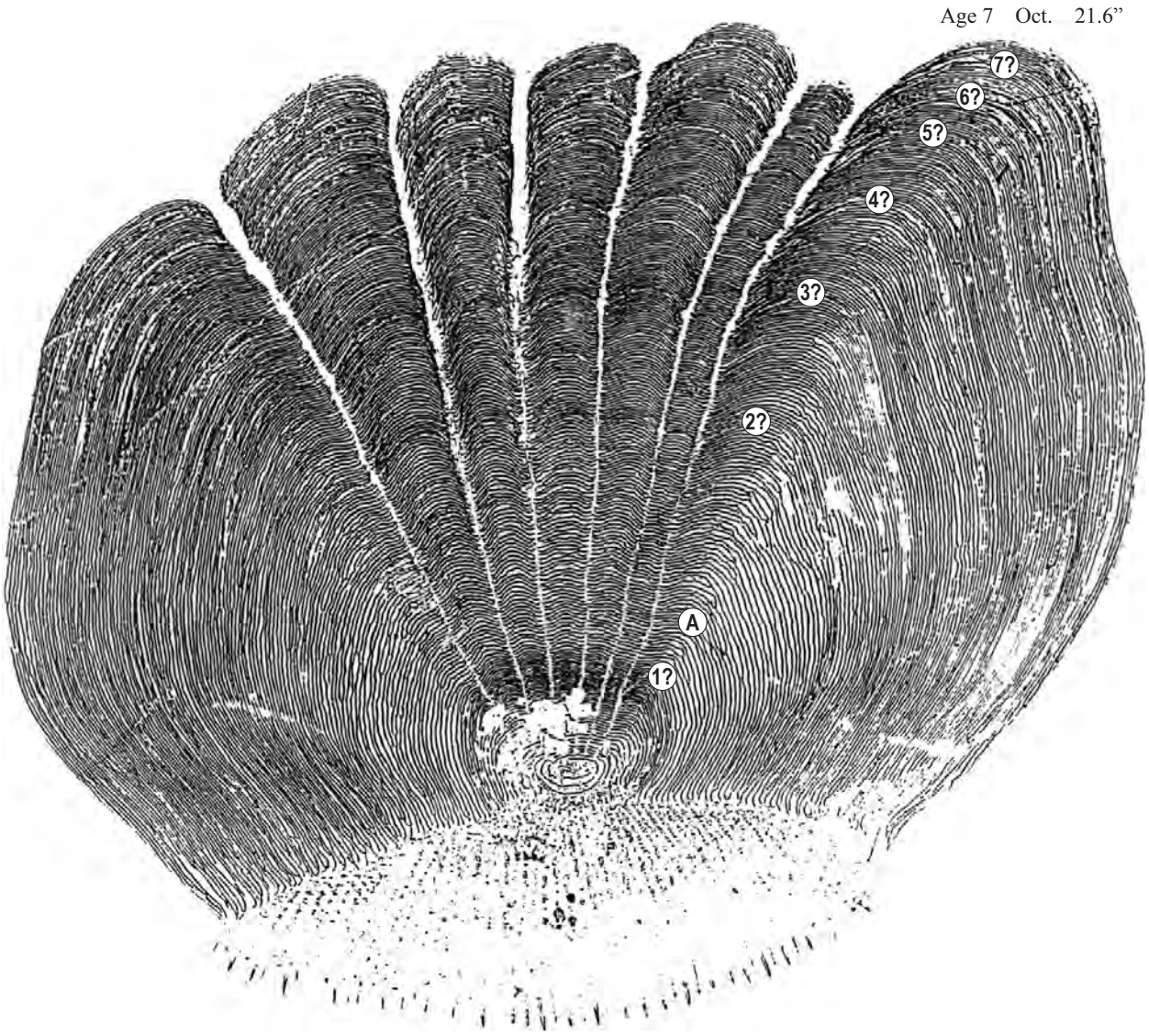


Figure 11.–Age 7 walleye. This Manistee Lake walleye had a RP (1977) stocking clip, like those in Figure 10a and 10b. Possibly then, the first annulus may be around “A” rather than “1”, or could even be up at “2?”. However, only seven likely-looking annuli are visible on the scale, making the indicated numbering the most likely. Alternatively, the first annulus could be at “2” and the seventh annulus could be invisibly close to the edge.

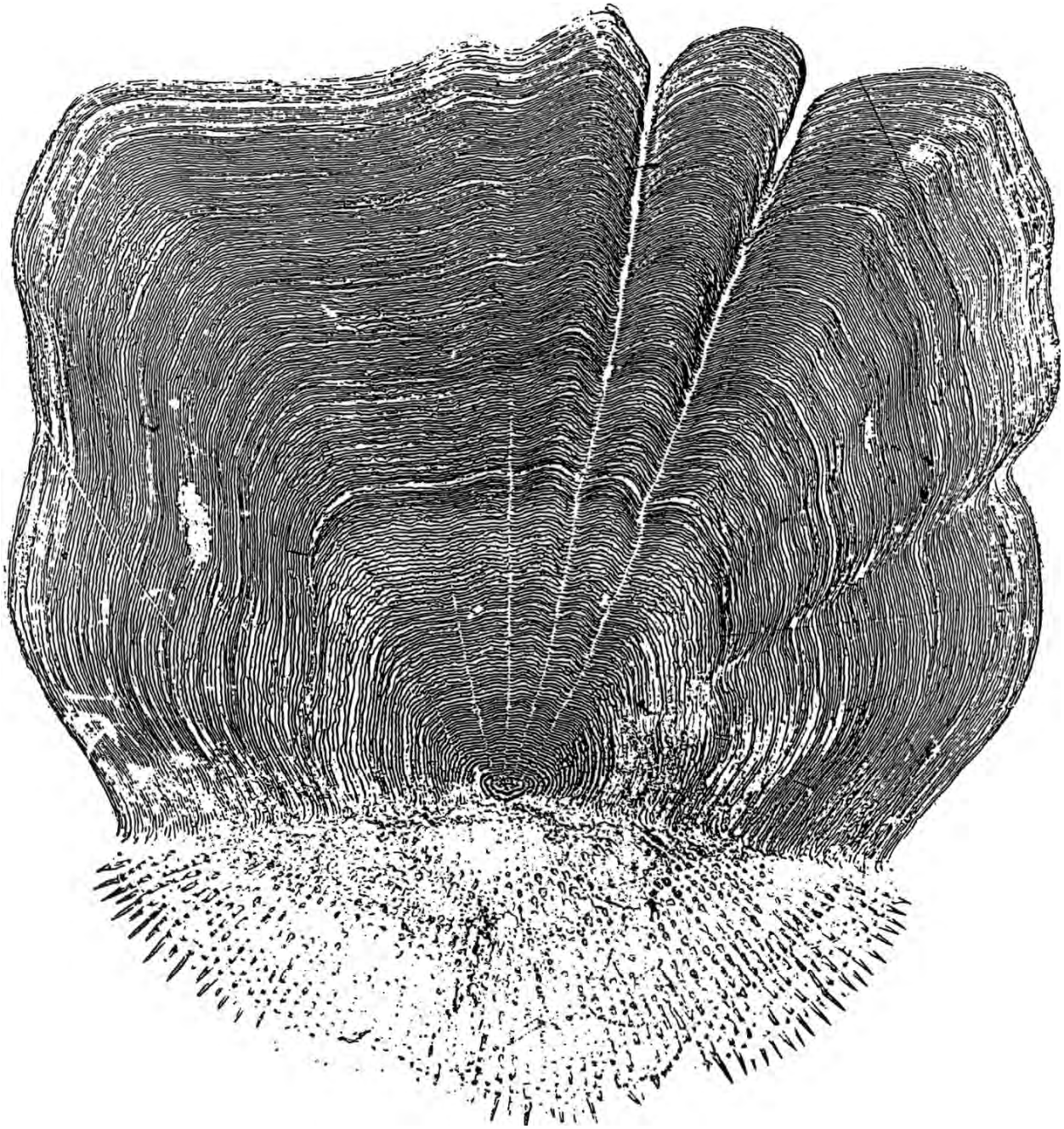


Figure 12.–Walleye; 21.3”; October 1984; Manistee Lake; 20X.

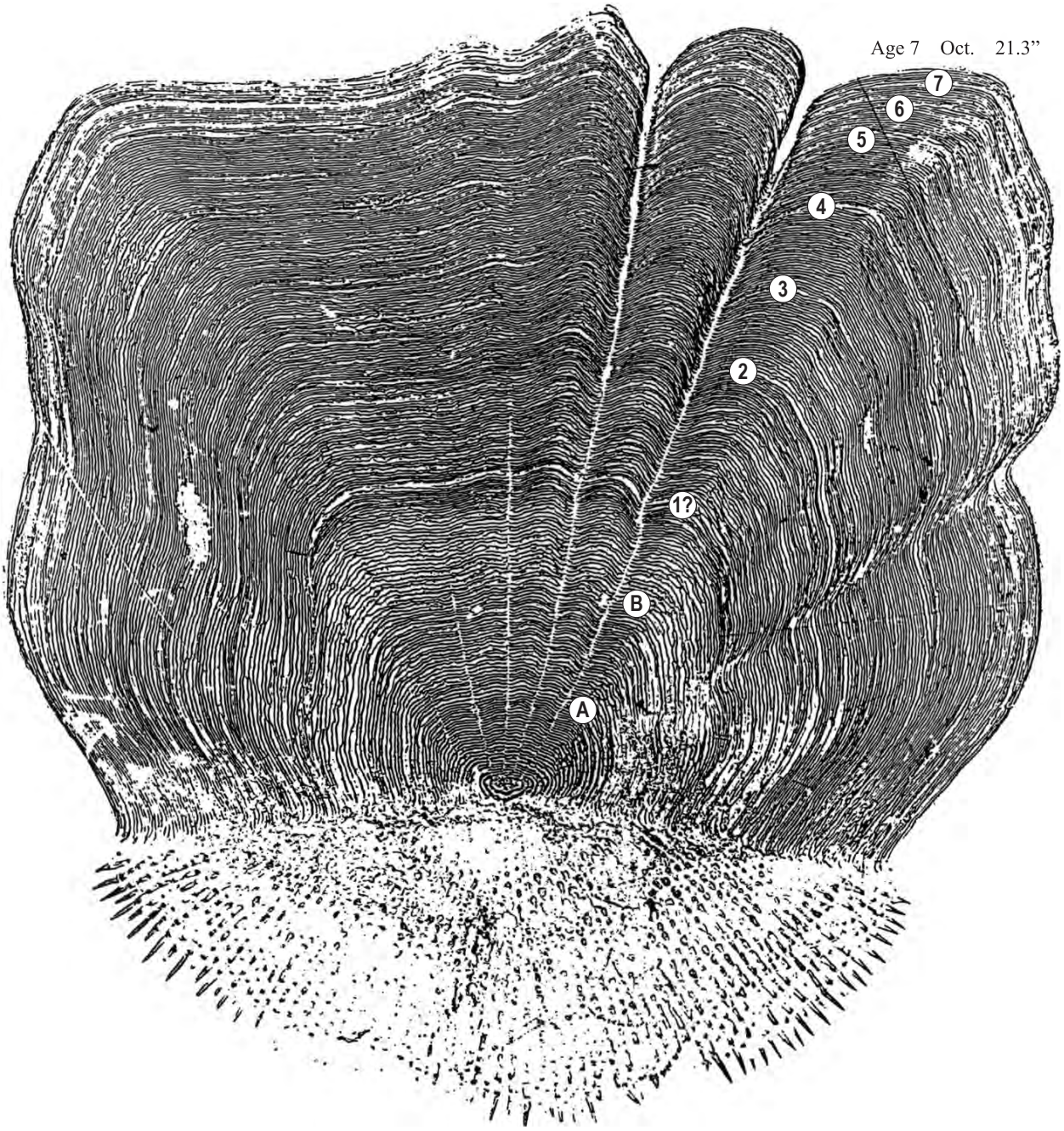


Figure 12.–Age 7 walleye. Stocked in Manistee Lake with RP clip (1977), same as in Figures 10a-b and 11. Could have easily been misaged as age 8. Growth pattern in first year believed to be as in Figure 9b, with two checks in the first year.

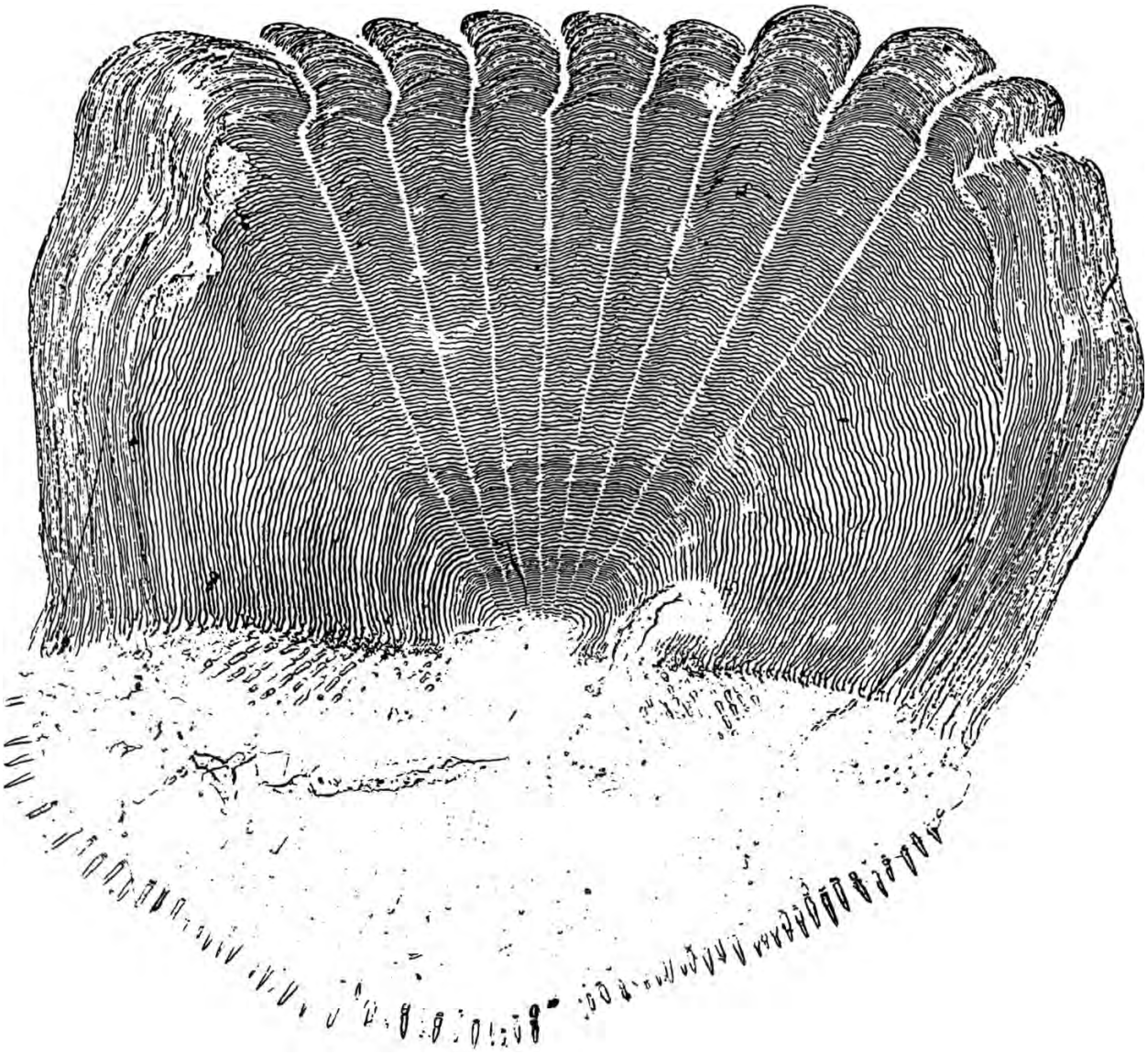


Figure 13.–Walleye; 15.6”; September 1988; Jewett Lake; 25X.

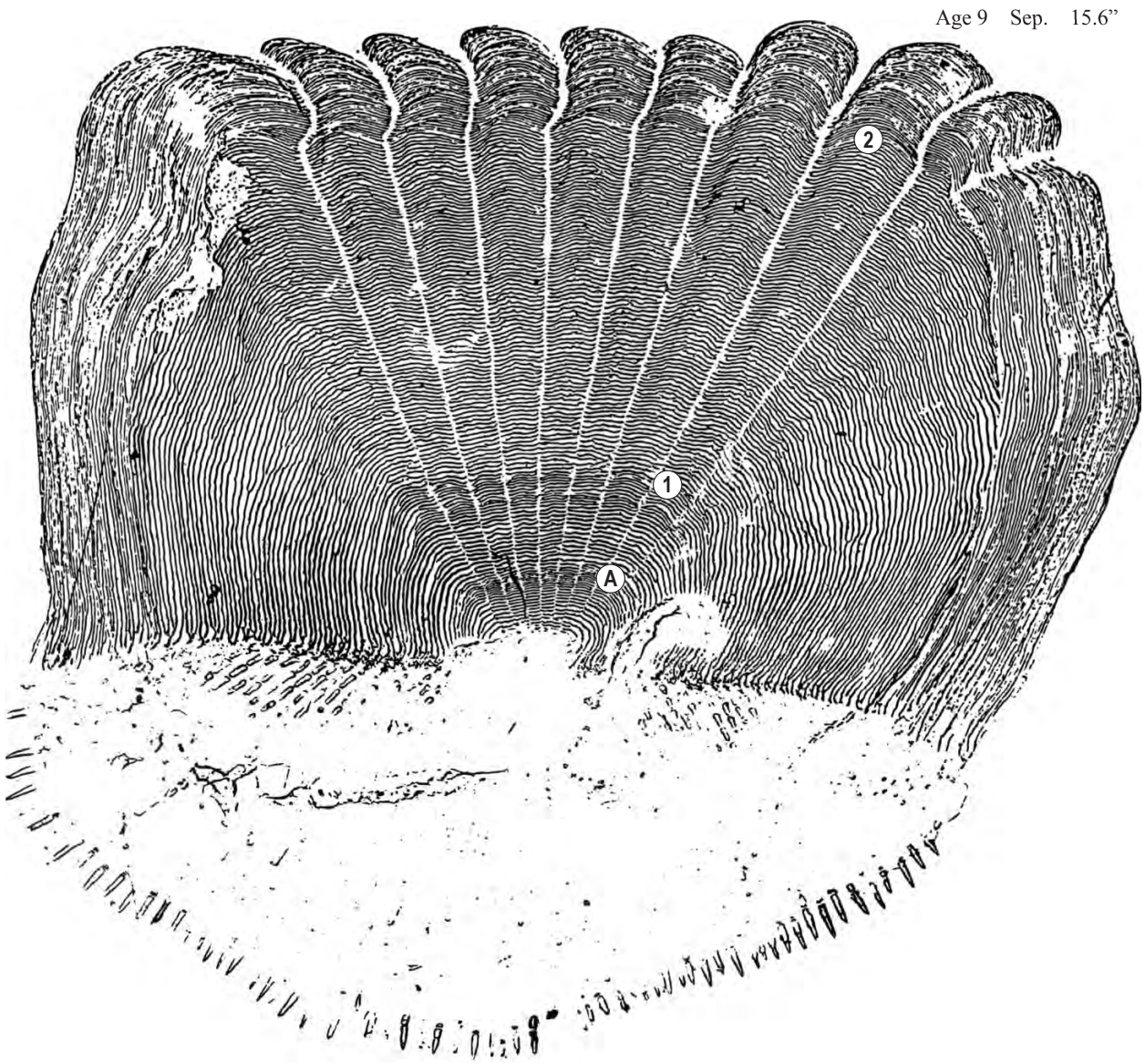


Figure 13.–Age 9 walleye. Stocked in Jewett Lake with RP clip (1979). Probably a check at “A”, like the fish in Figure 5; annuli at ages 1 and 2 are obvious. Impossible to pinpoint all seven additional annuli which are known to be on this scale, but could imagine about five more from the irregularities in the anterior field. The close spacing of irregular circuli and signs of resorption are clues that this fish may be even older than he (probably a stunted male) appears from this scale.

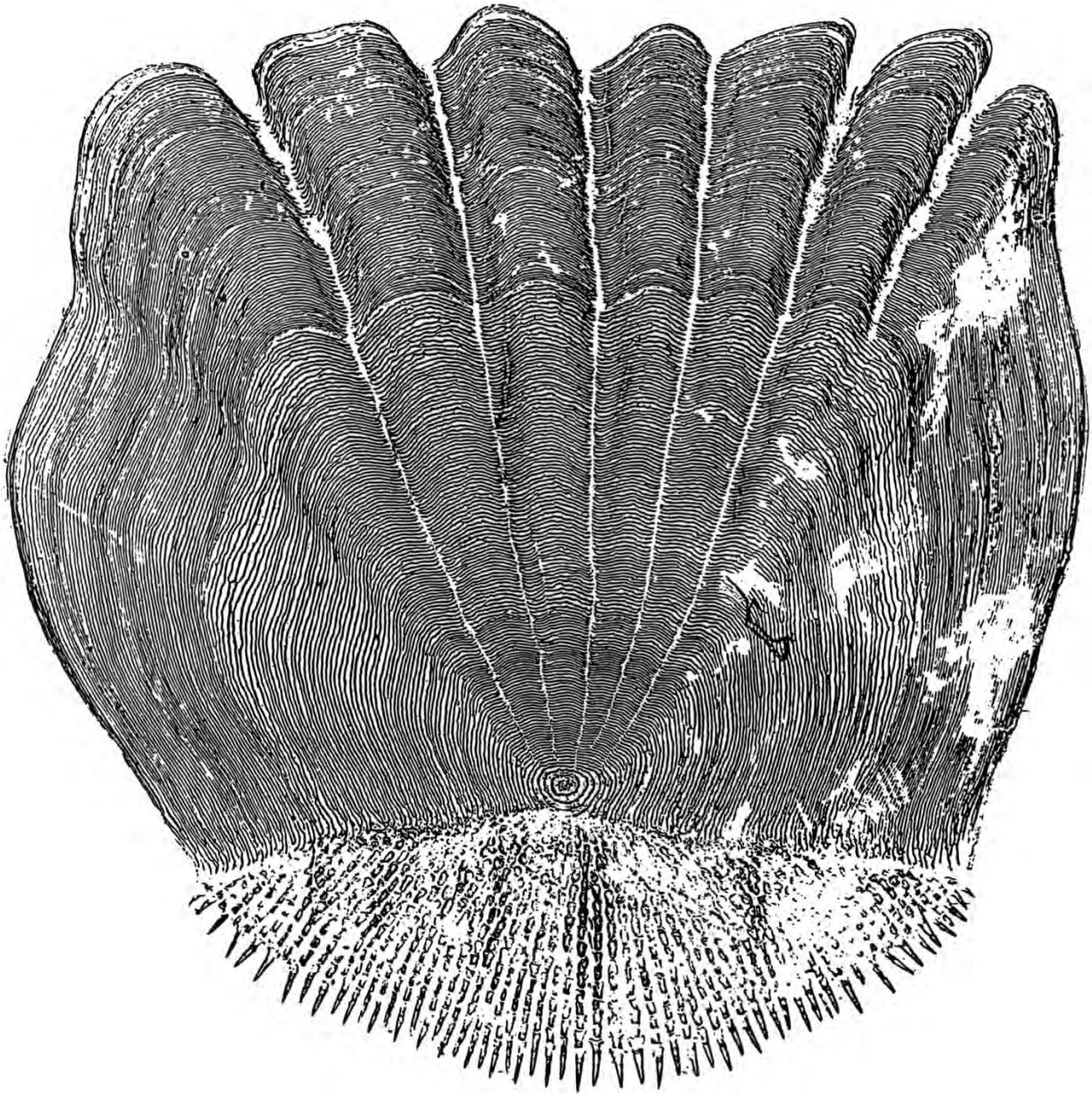


Figure 14.–Walleye; 16.0”; September 1988; Jewett Lake; 25X.

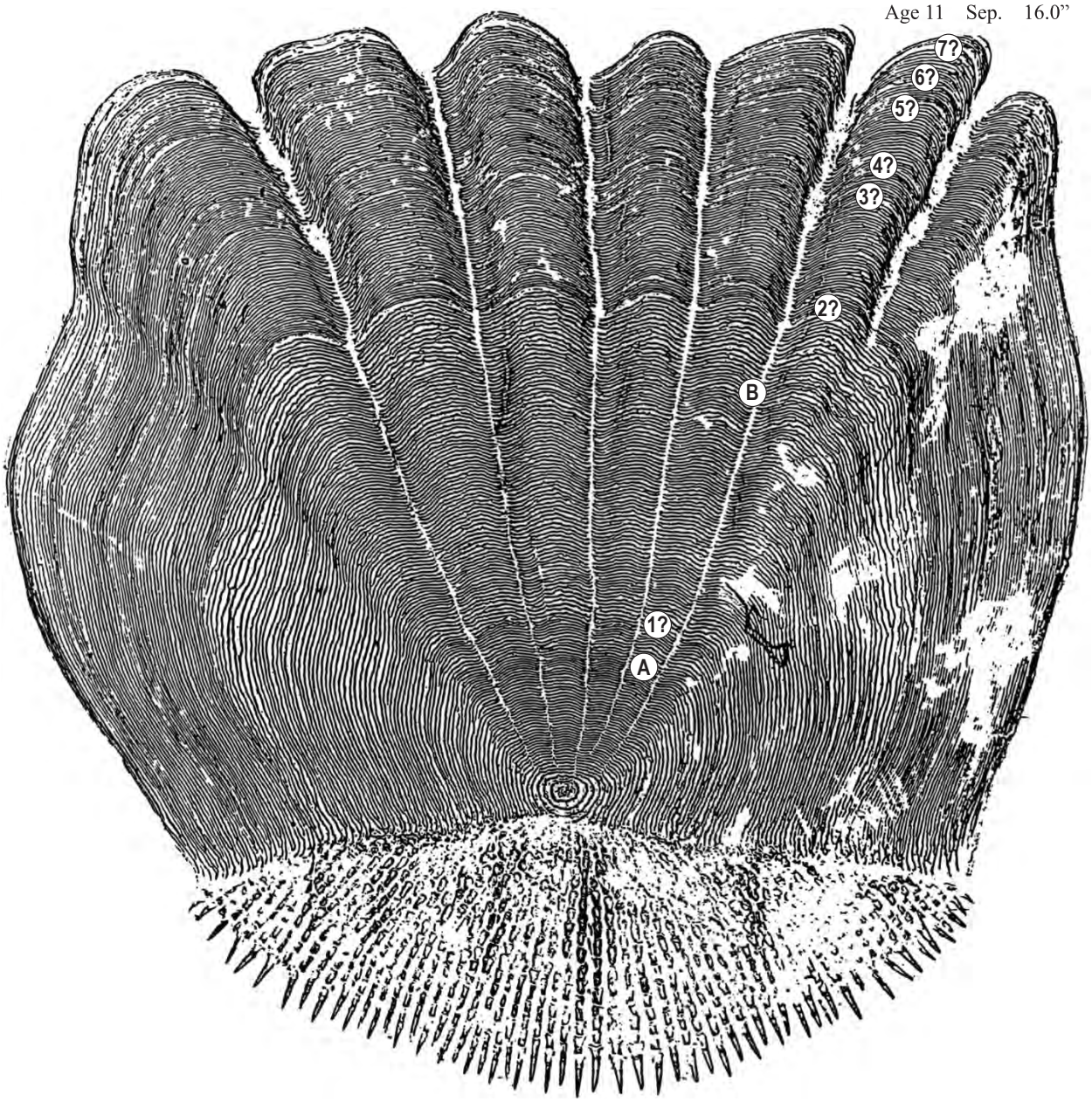


Figure 14.–Age 11 walleye. Stocked in Jewett Lake with LP clip (1977). This scale is disconcerting because seven annuli are fairly evident, as marked, and the reader would feel fairly confident. There is not much evidence of resorption to tip-off the reader that four more annuli should be present. Apparently, the missing annuli are somewhere near the edge. There was a spurt of fall growth at “A” (following stocking) and also at “B”. Note this fish was only 16 in long.

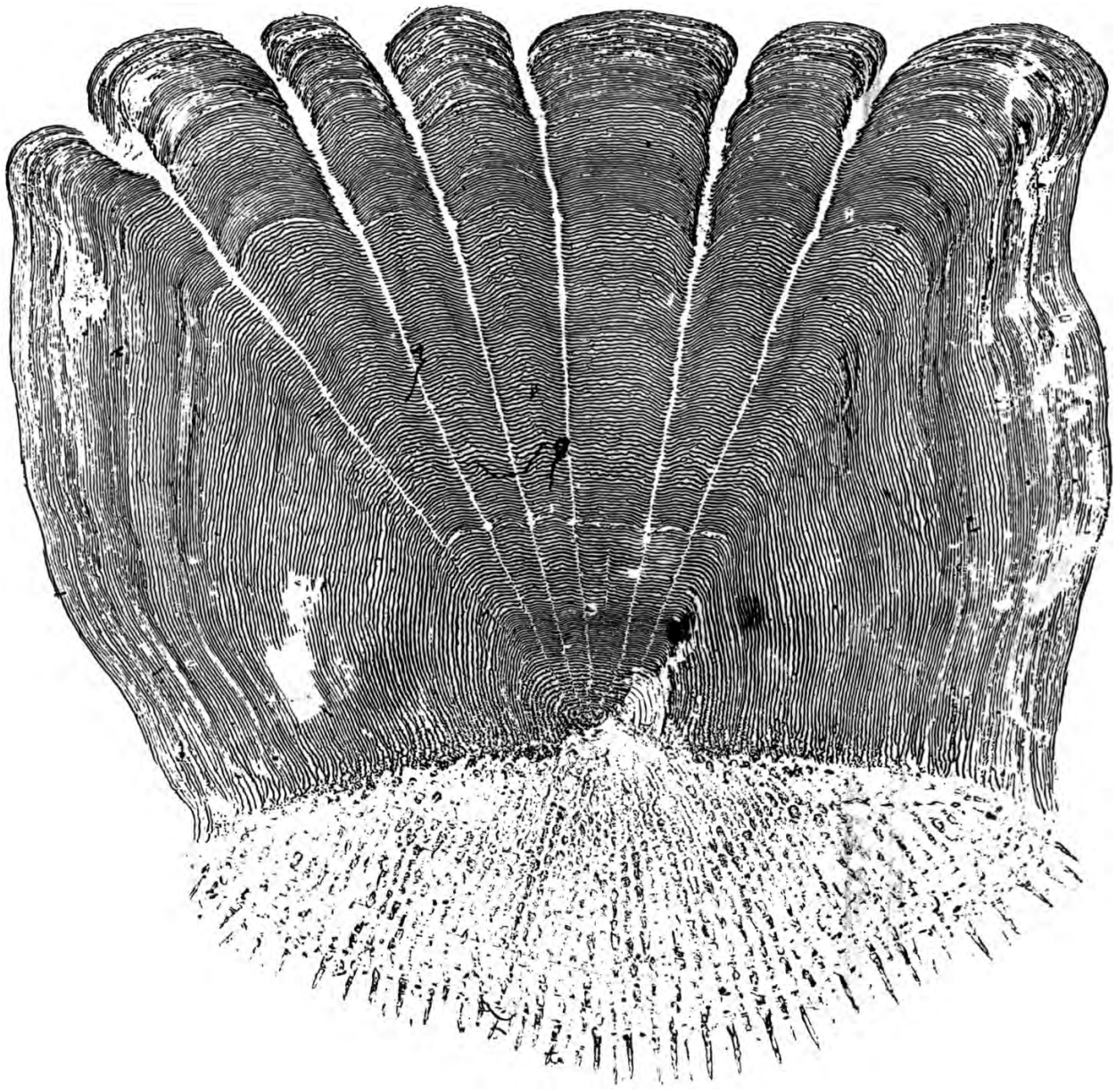


Figure 15.–Walleye; 18.6”; September 1990; Jewett Lake; 25X.

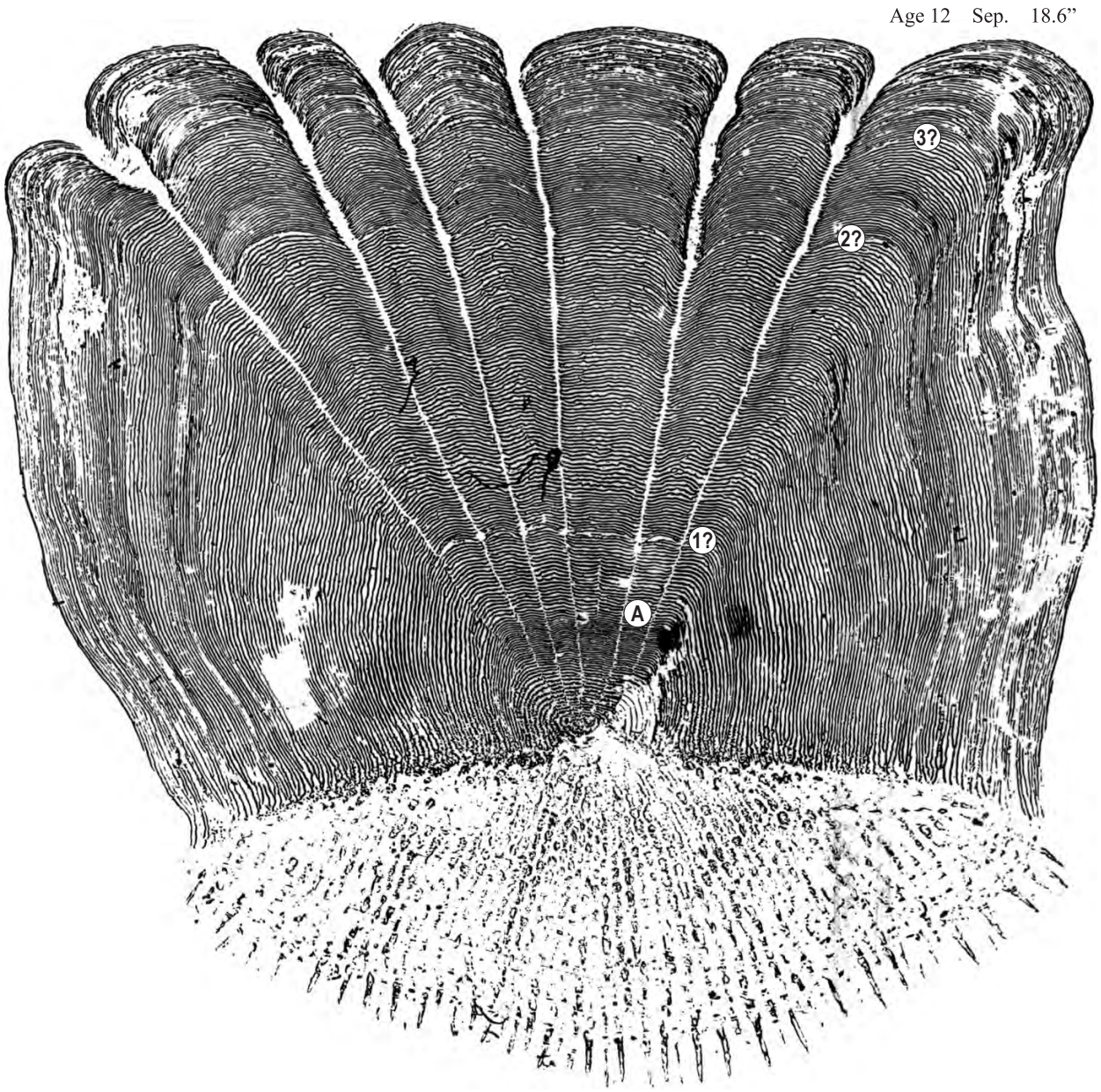


Figure 15.–Age 12 walleye. Stocked in Jewett Lake with LV clip (1978). Extensive resorption and irregularities are a tip-off that this scale is impossible to age, and is probably at least age 9. The most likely locations of the first three annuli are marked; the check at “A” occurred either in the rearing pond or after stocking.

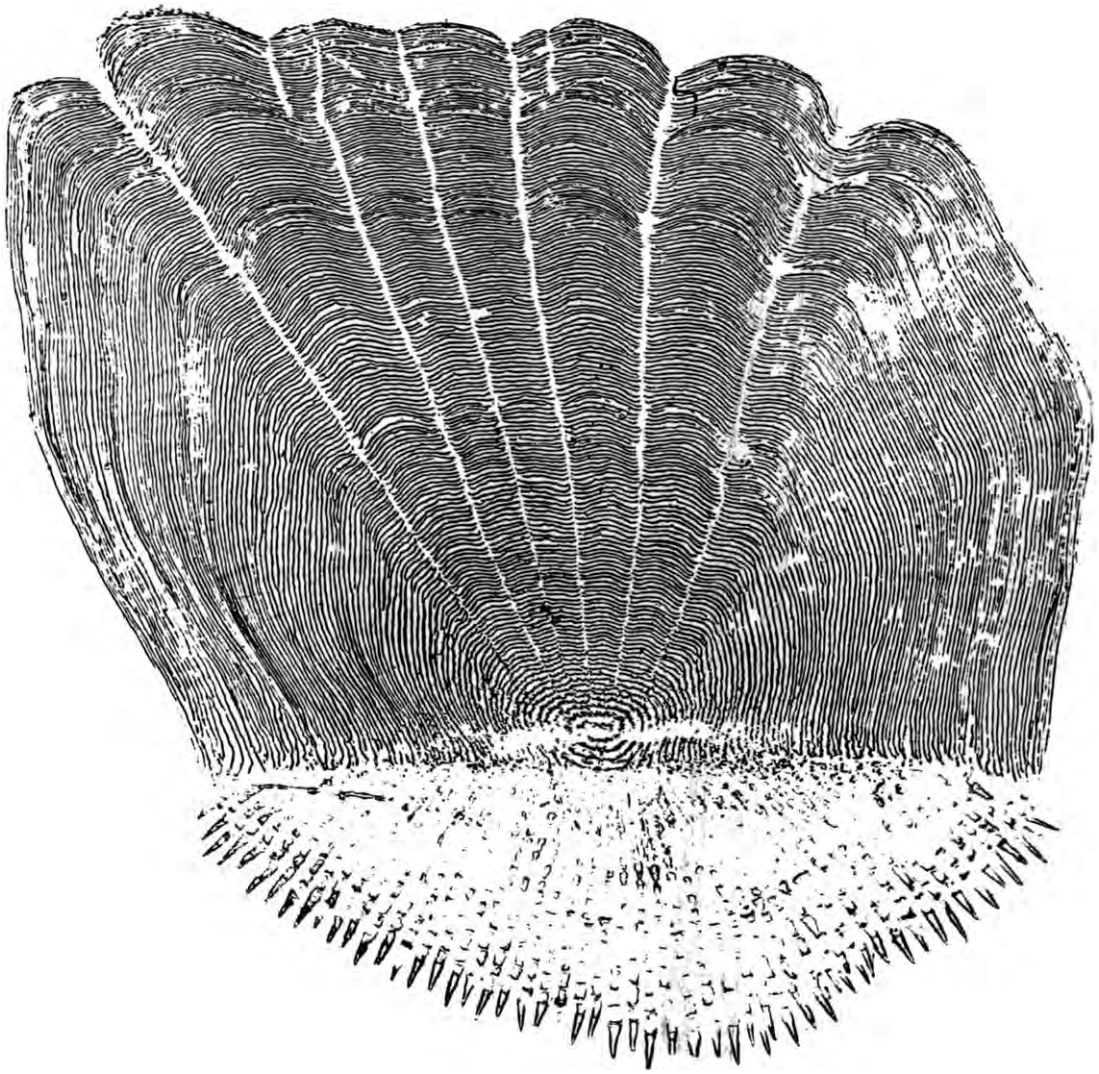


Figure 16.–Walleye; 14.6”; September 1981; Jewett Lake; 25X.

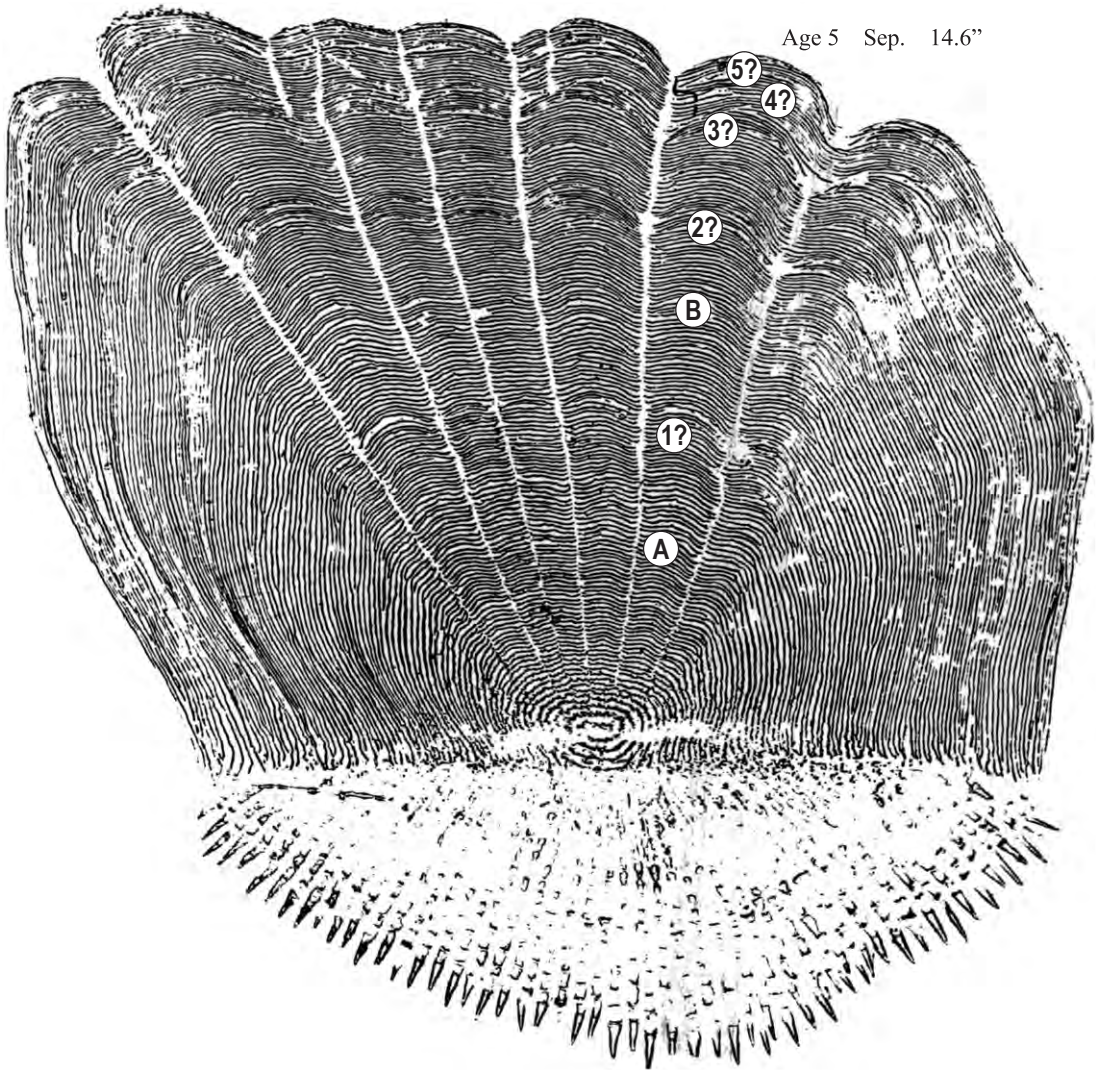


Figure 16.–Age 5 walleye. Belongs to a group of large (6.4-8.5 in) fingerlings stocked in Jewett Lake in 1976. Issued tag no. 04213 in the fall of 1979 when 13.1 in long (corresponding on the scale to just inside the “4?” mark). Thus, it grew only 1.5 in during the last 2 years (only about 0.4 in on the scale). A reader experienced with scale patterns in this population would probably age it correctly at 5 or older, properly interpreting “A” and “B” as checks. “B” is interpreted as a check because the second annulus is almost always very distinct and other fish show much better growth during the second year. The third and fourth annuli are probably very close together (as marked) because of the irregularity of the anterior circuli (even though there seems to be only one crossing over in the lateral field); the alternative interpretation is that there is an unseen annulus at the edge. The reader should be suspicious that the fish might be older than 5, given evidence of resorption and close spacing of annuli toward the edge.

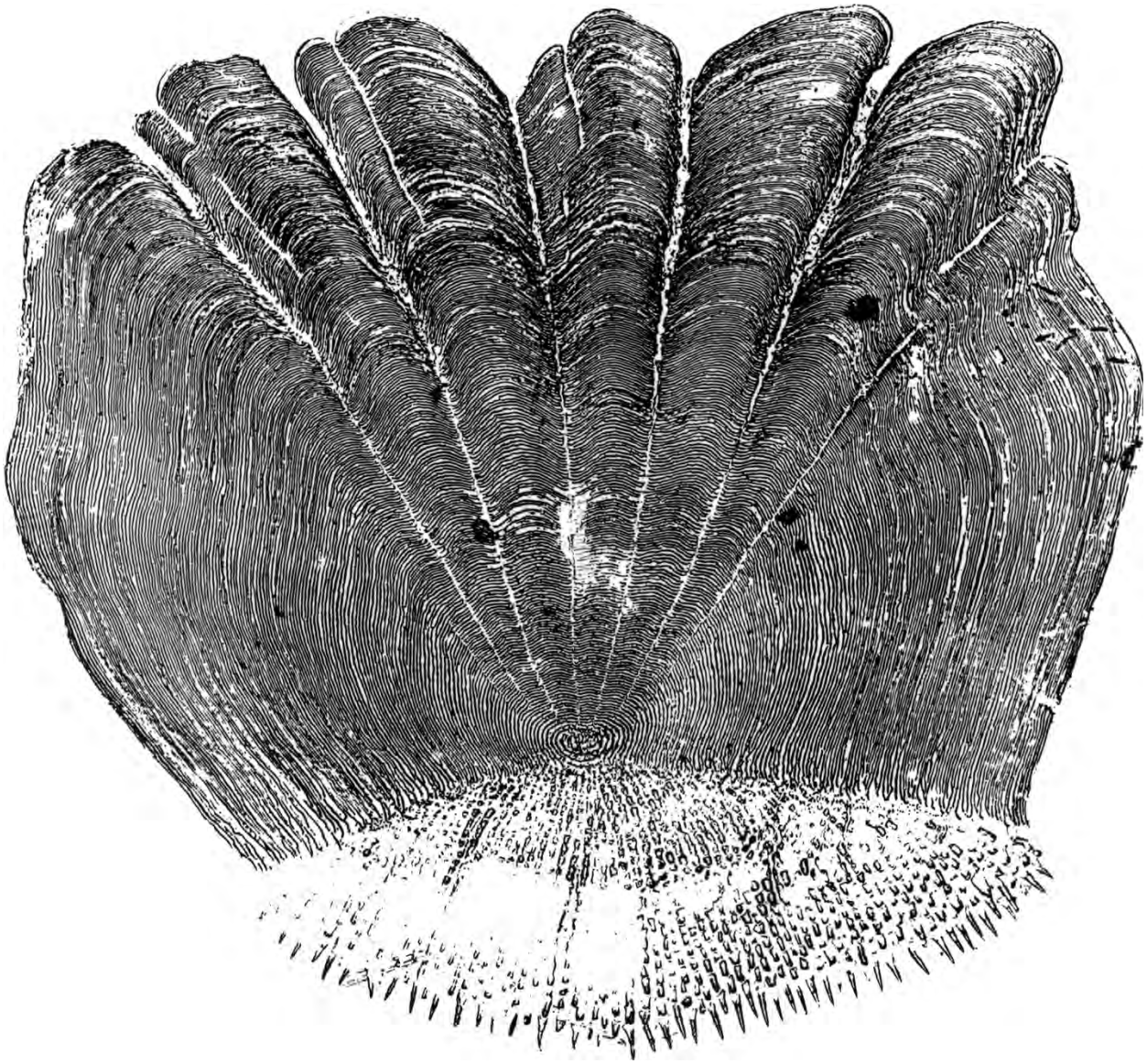


Figure 17.–Walleye; 19.3”; October 1987; Jewett Lake; 20X.

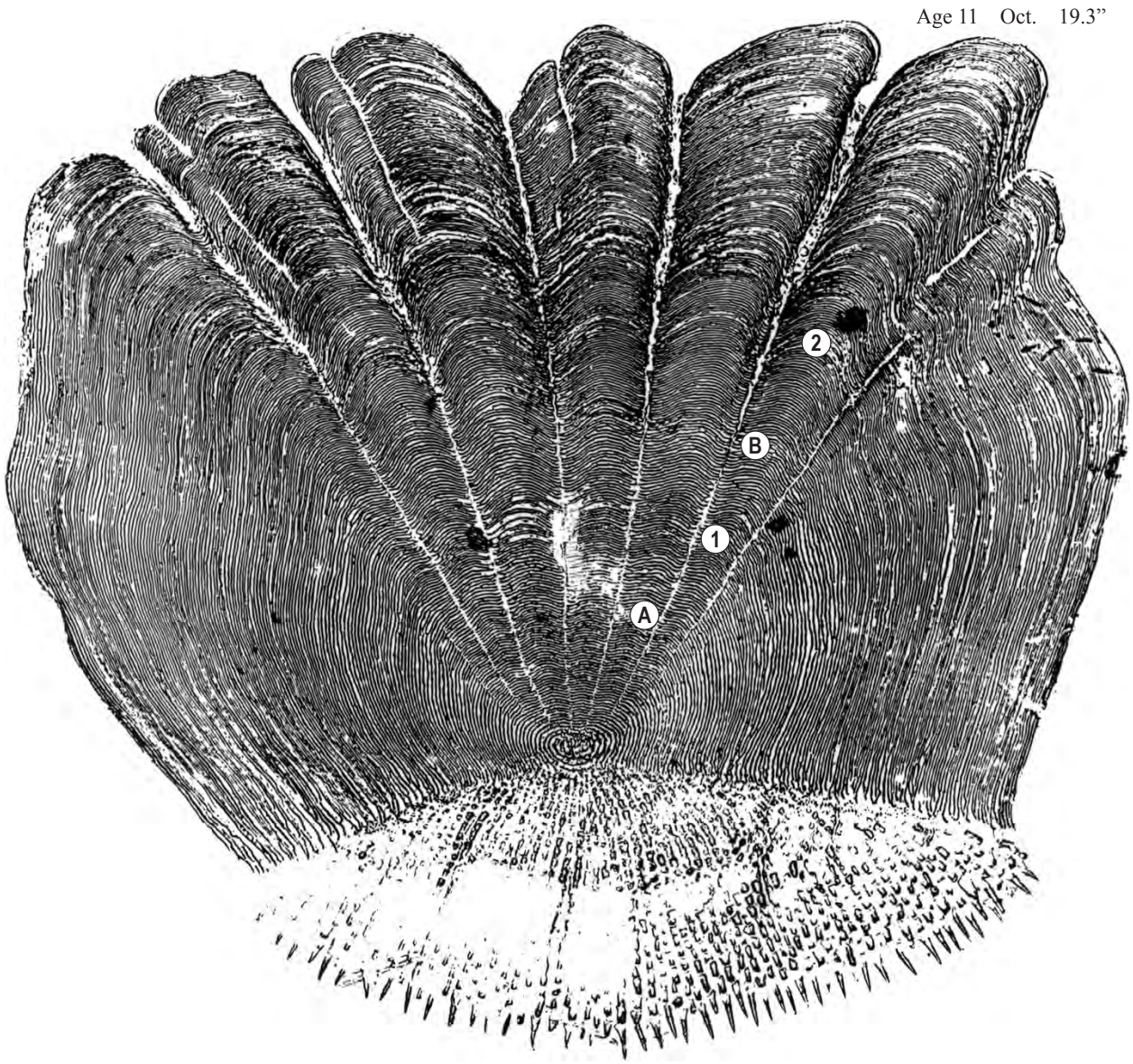


Figure 17.–Age 11 walleye. The same fish as Figure 16, 6 years later, still with tag no. 04213 (stocked in 1976). One could probably estimate about 10 annuli on this scale. Checks at “A” and “B” are still evident. In the later years, growth was apparently better in some years than in others.

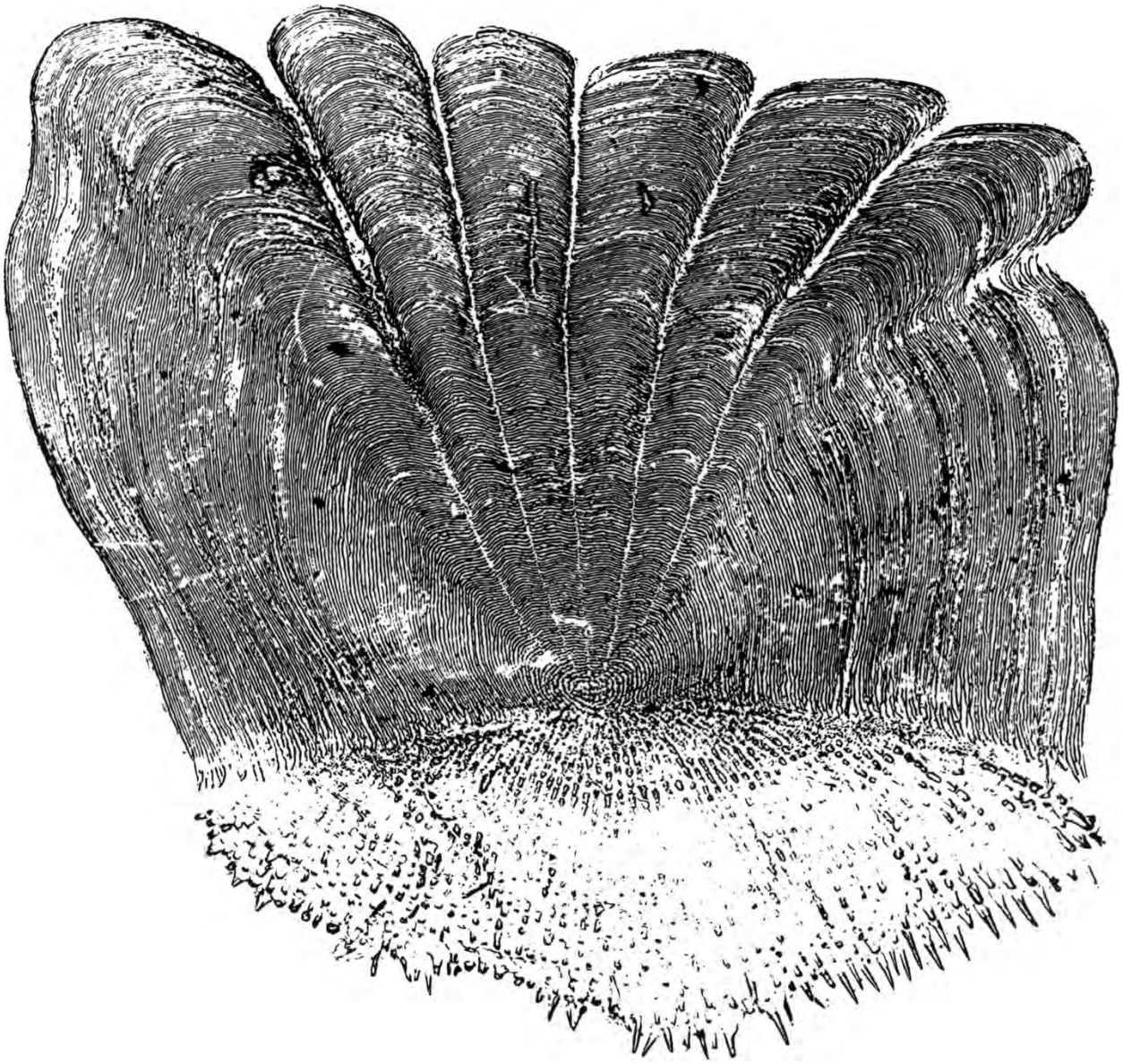


Figure 18.–Walleye; 20.4”; October 1990; Jewett Lake; 20X.

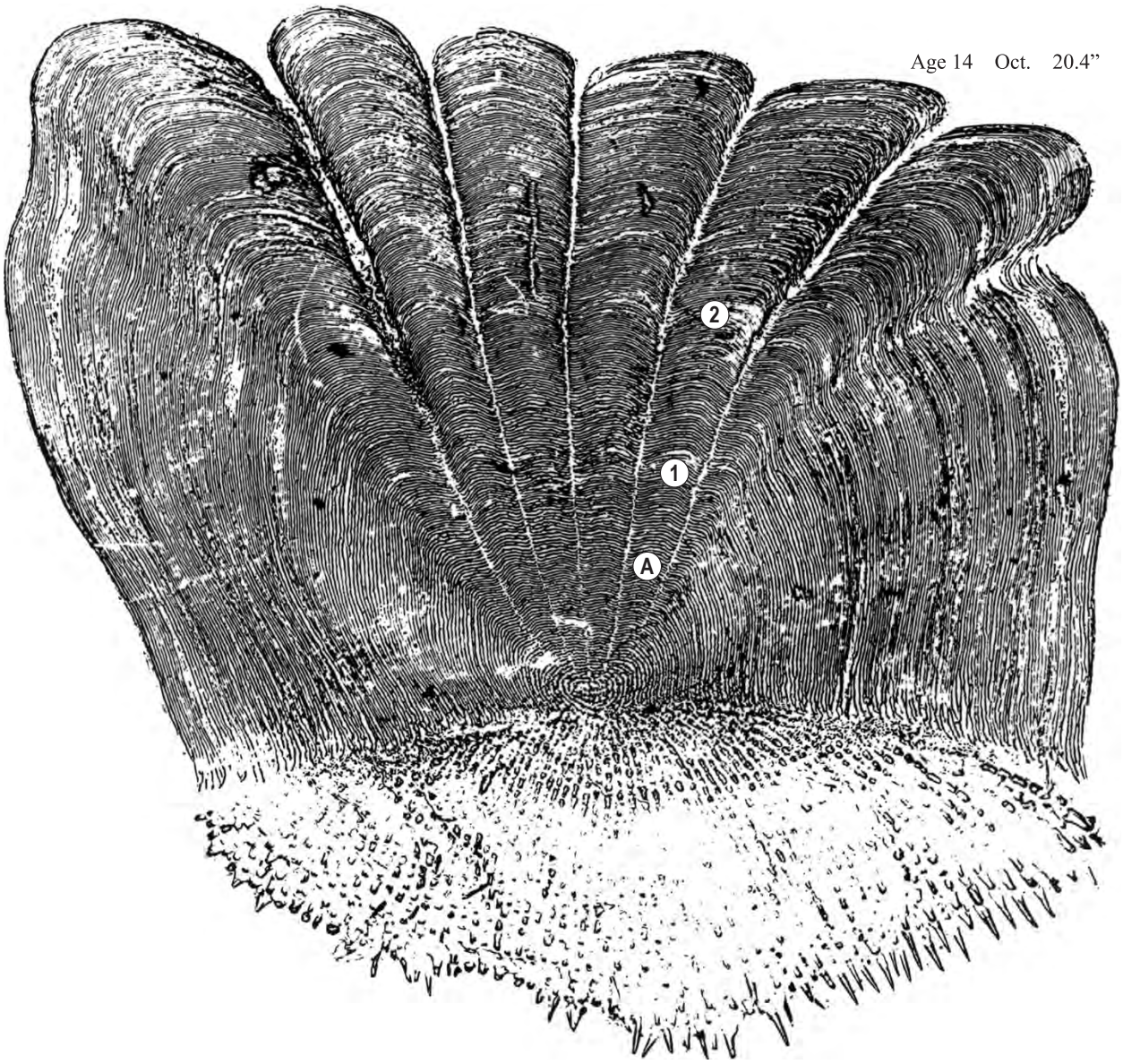


Figure 18.–Age 14 walleye. The same fish as in Figures 16 and 17, still with tag no. 04213. The scale from this fish is evidently old, and we could be content to call it age 9 or older. However, it shows relatively good growth the “last” year and the edge is “clean”, so one would probably guess all the annuli are visible and might call it about age 9 with fair confidence. But, Figure 18 looks identical to Figure 17, indicating that there must be four unseen and unsuspected annuli on the edge. Another scale sample from this fish, taken in fall 1988 at a length of 19.6 in, likewise showed no scale growth after 1987. Actually, this walleye increased in body length by 1.1 in between 1987 and 1990.

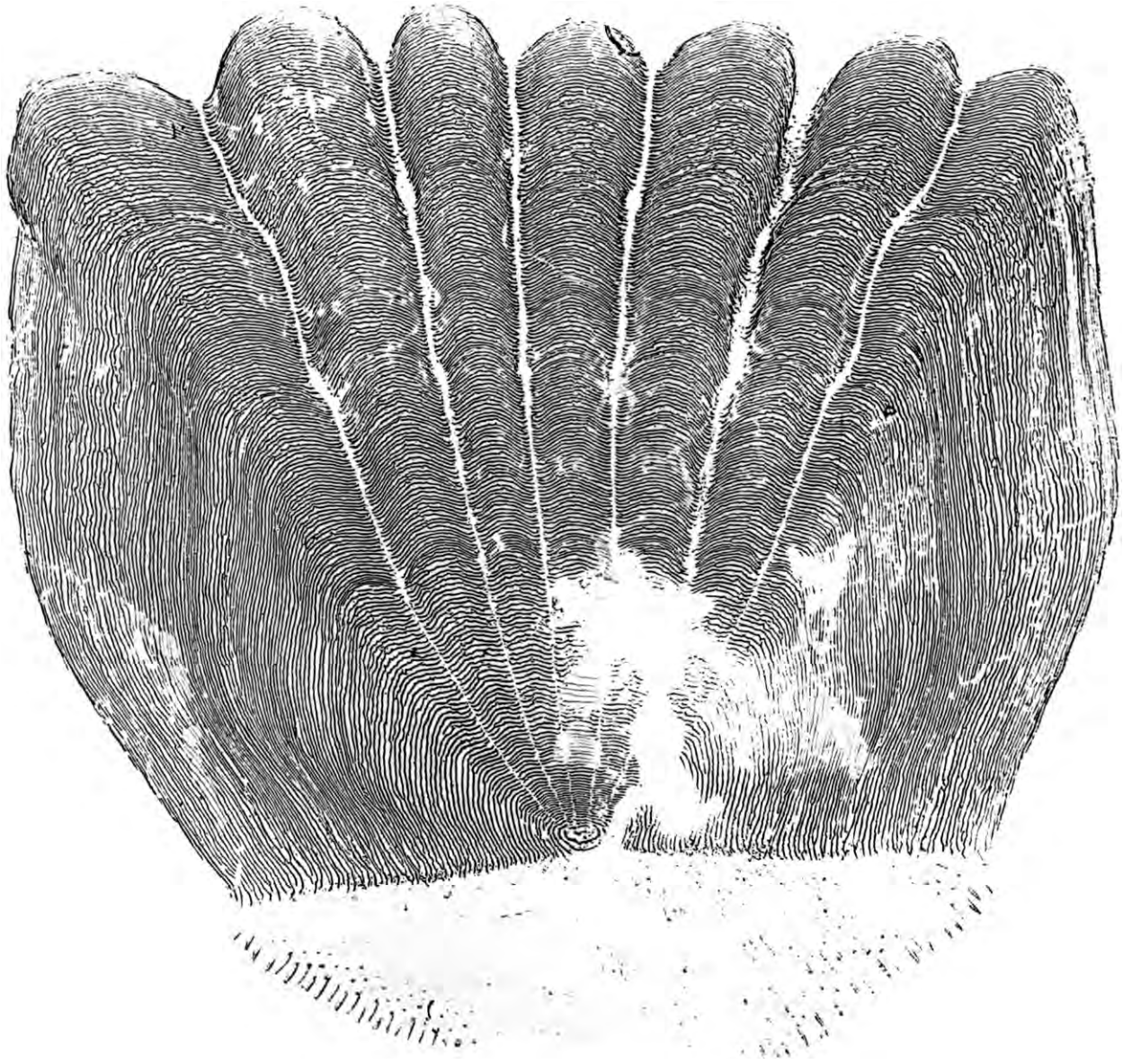


Figure 19.–Walleye; 17.7”; Male; April 1990; Lake St. Clair; 20X.

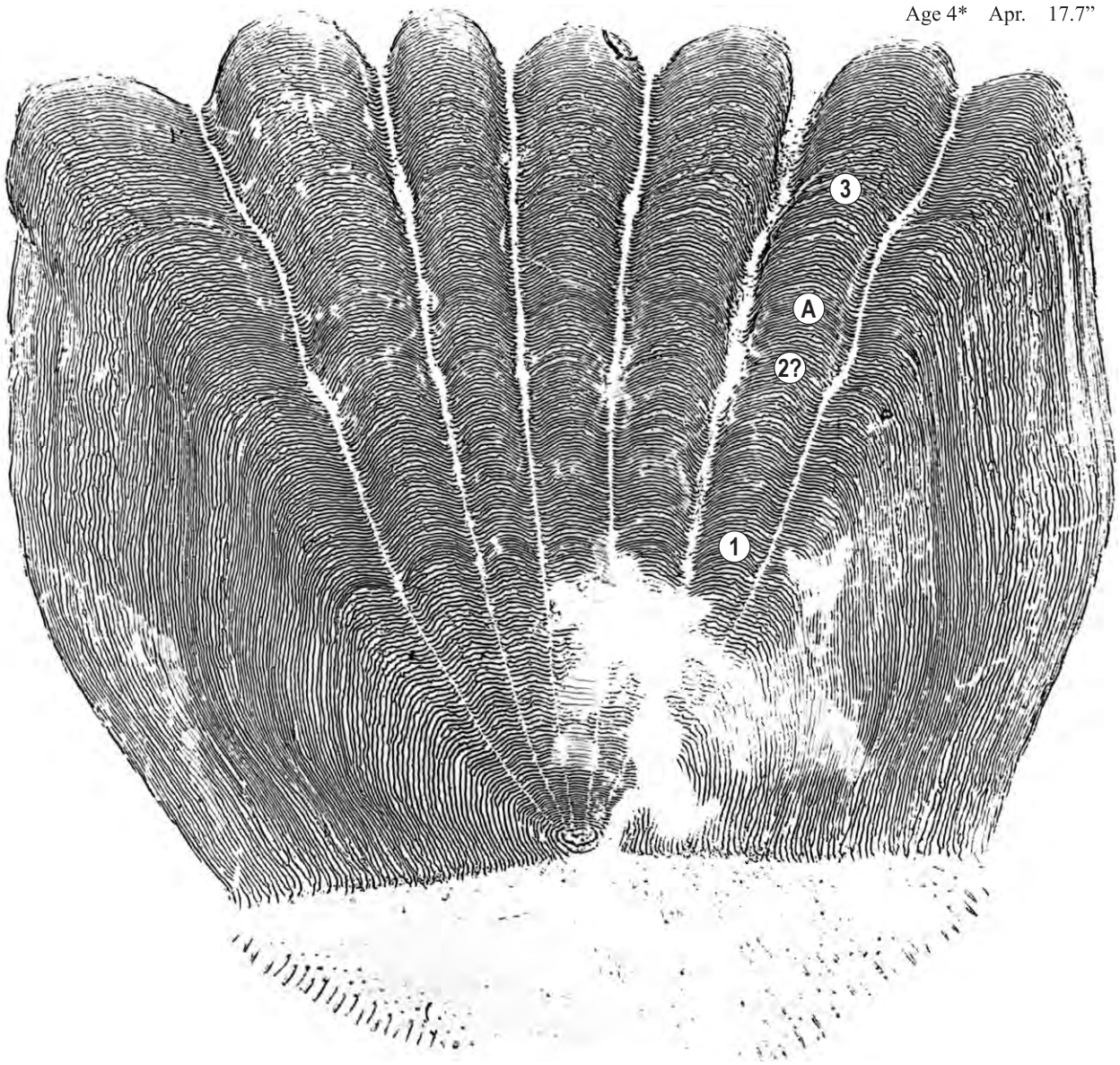


Figure 19.–Age 4* walleye. Issued jaw tag A3561 on October 15, 1986, at age 0, 8.8 in. There is a check, probably located at “A”, but possibly at “2?”. The crossing over seems to line up with “2?”.

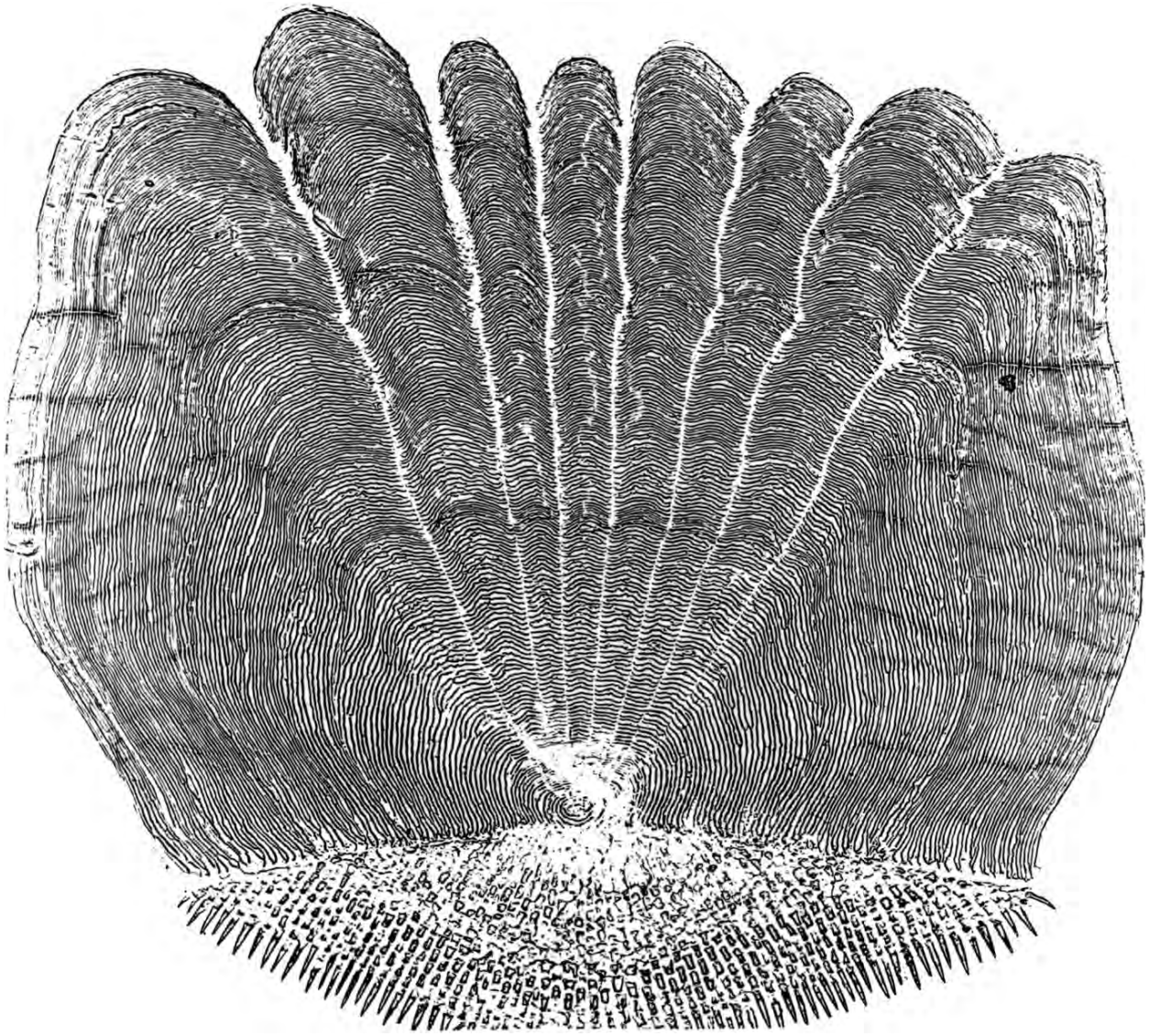


Figure 20.–Walleye; 17.8”; Male; March 1990; Lake St. Clair; 20X.

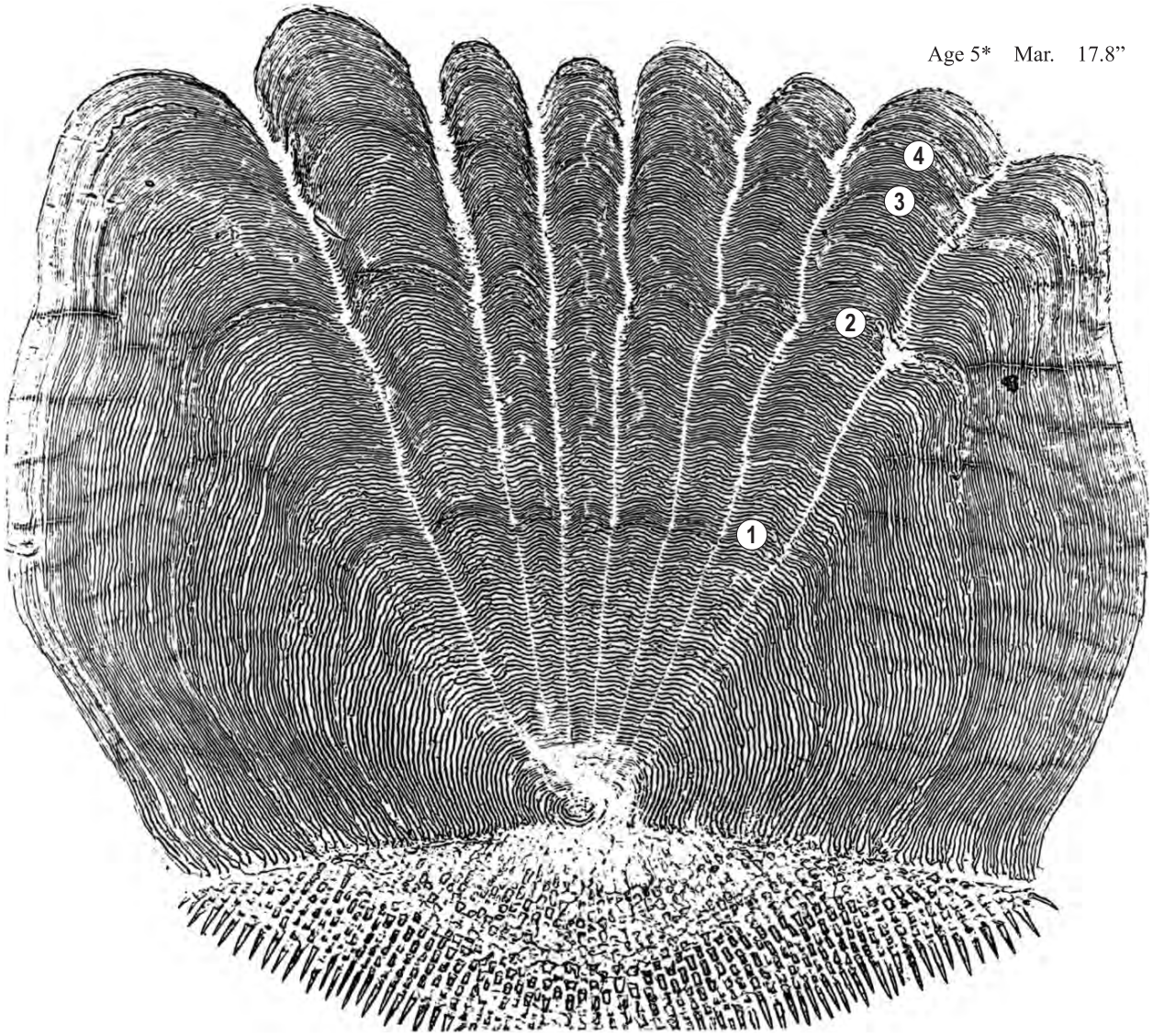


Figure 20.–Age 5* walleye. Issued jaw tag A2873 on October 22, 1985, at age 0, 8.5 in. Crossing over is clearest in 9 PM field, pattern is clearest in 11 PM field.

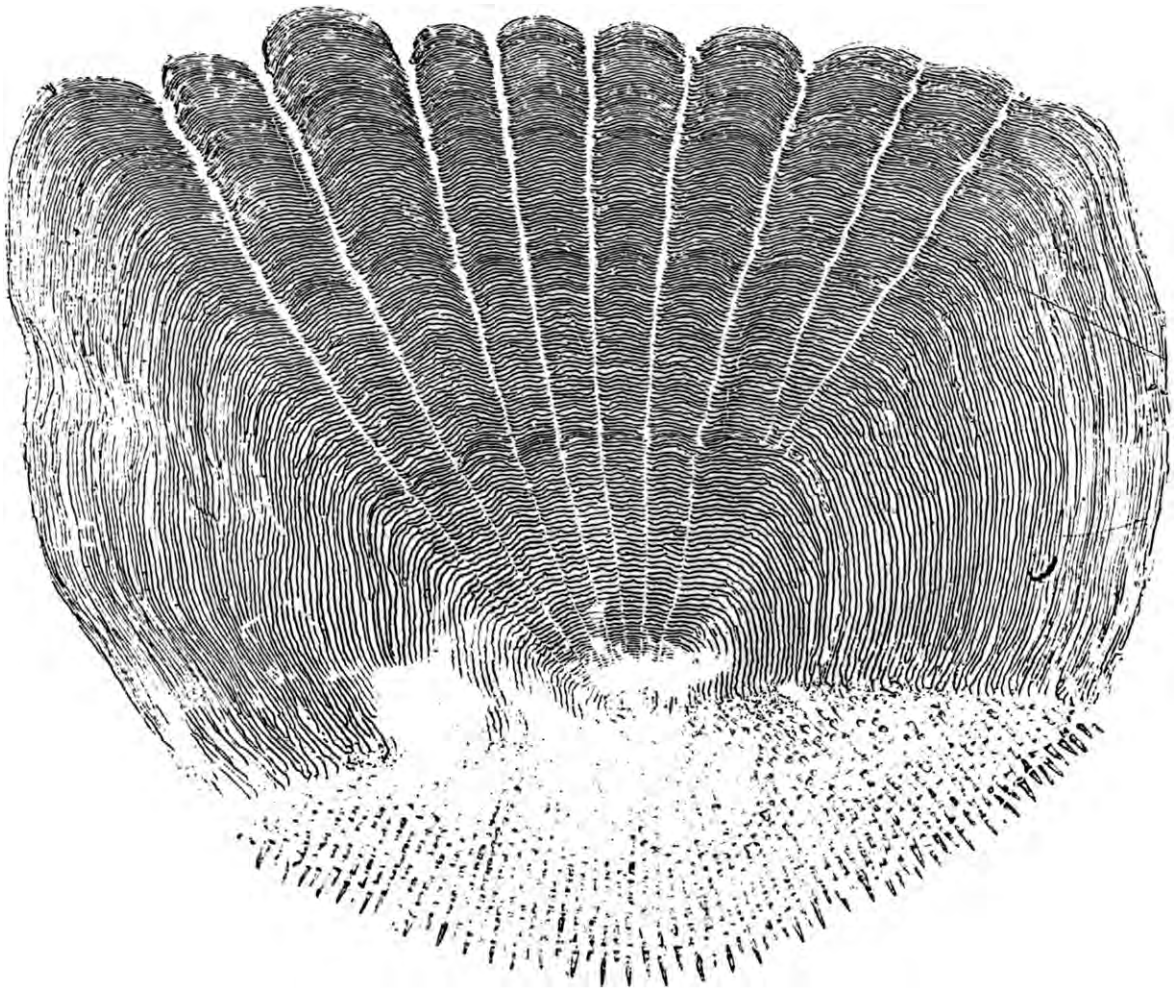


Figure 21.–Walleye; 16.8”; March 1991; Lake St. Clair; 20X.

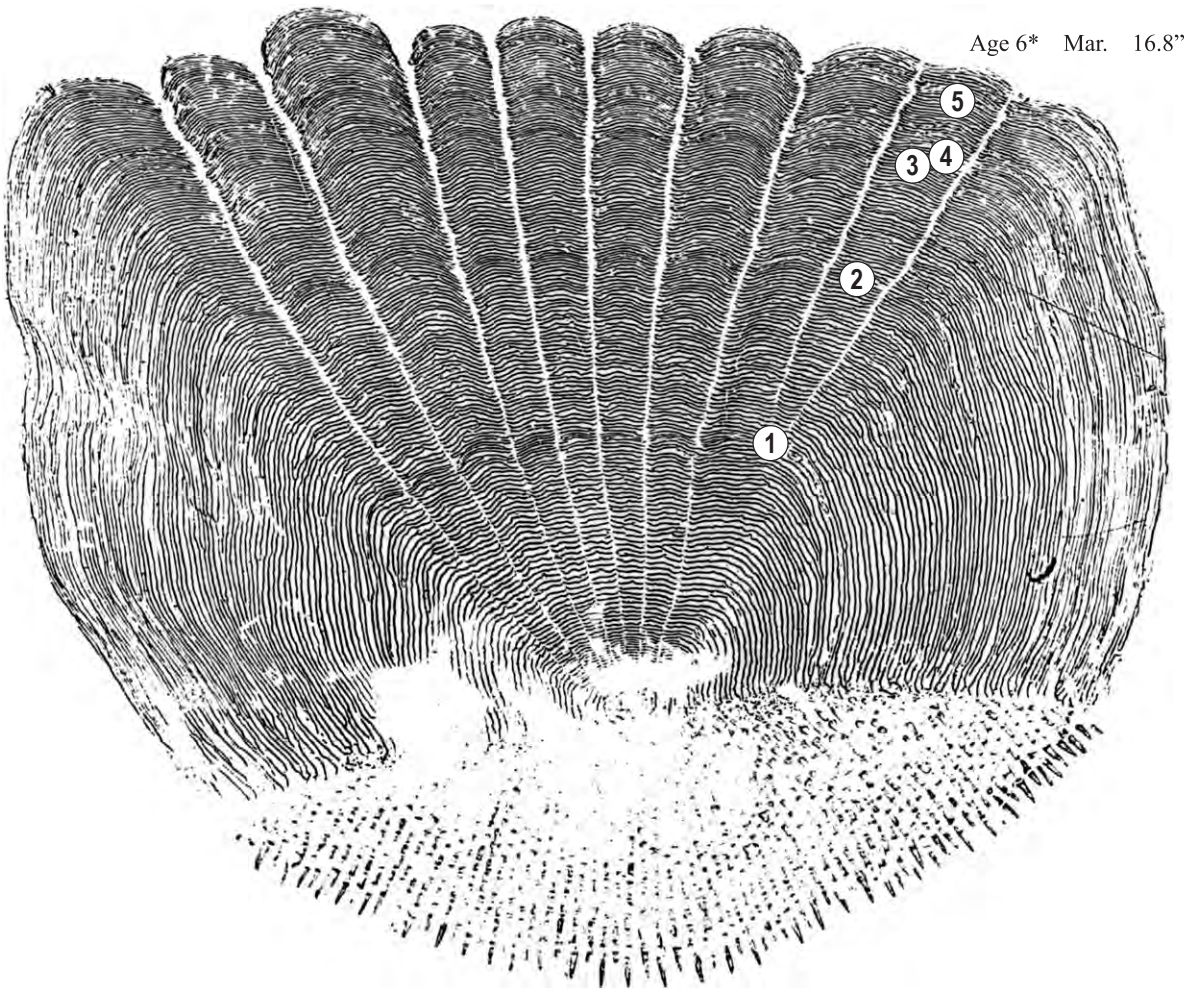


Figure 21.–Age 6* walleye. Issued jaw tag A2849 on October 22, 1985, at age 0, 7.5 in. Difficult because annuli 3 and 4, and 5 and 6 are so close together.

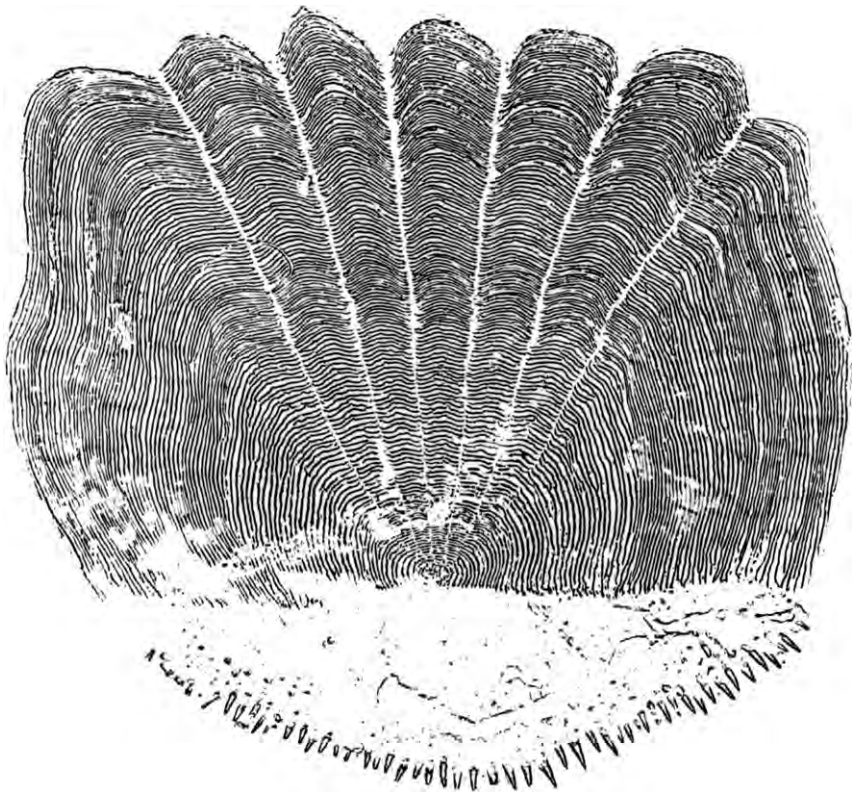


Figure 22.–Walleye; 14.1”; male; April 1990; Lake St. Clair; 20X.

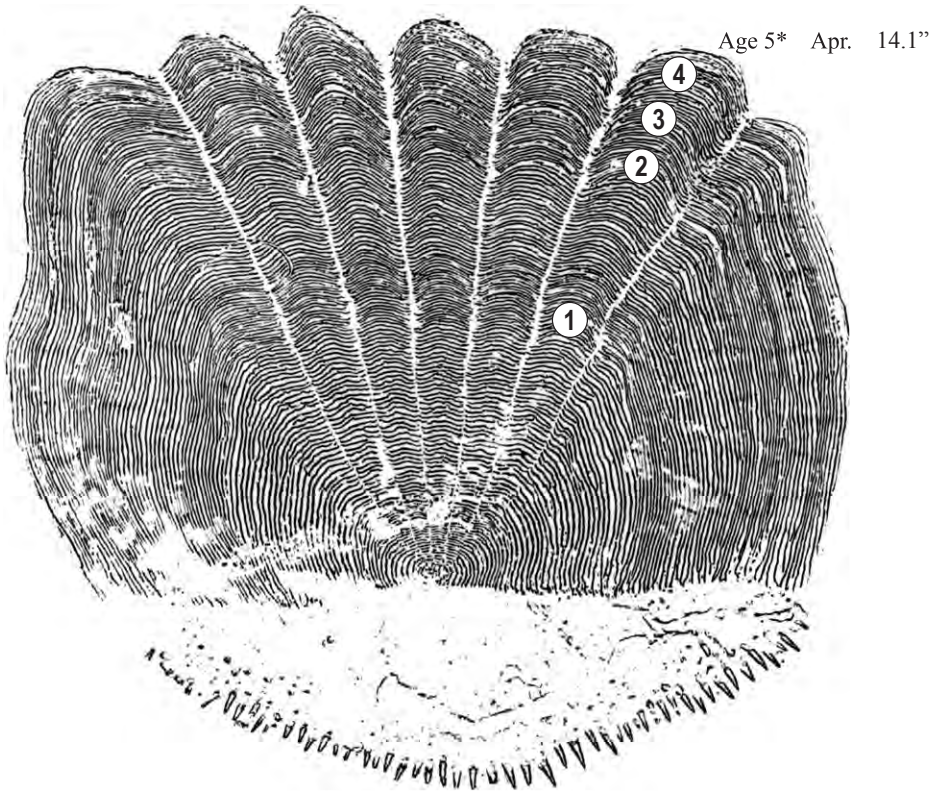


Figure 22.–Age 5* walleye. Issued jaw tag A2815 on October 22, 1985, at age 0, 7.2 in. Growth probably retarded by jaw tag.

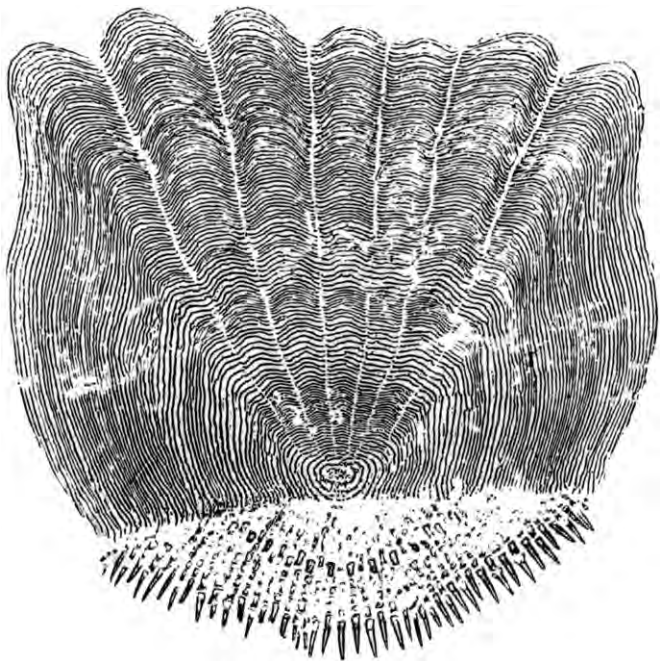


Figure 23.–Walleye; 10.5”; March 1990; Lake St. Clair; 20X.

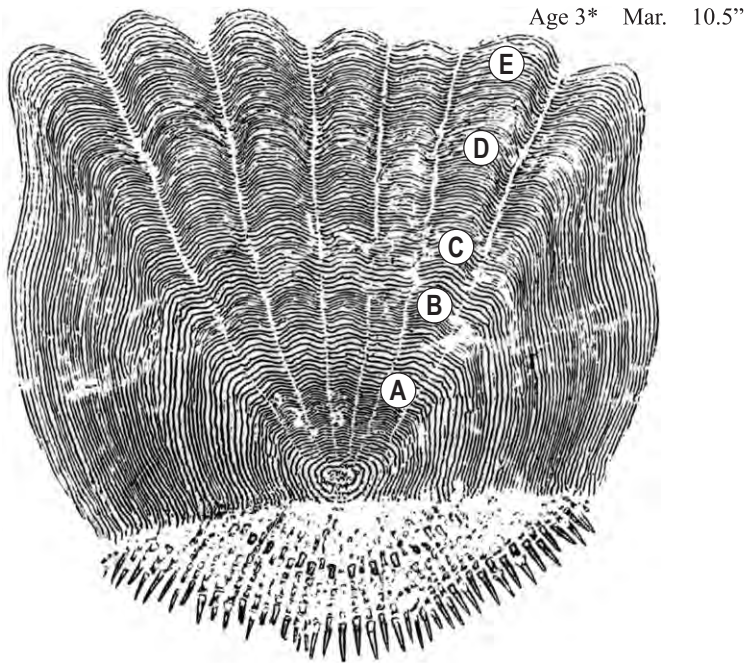


Figure 23.–Age 3* walleye. Issued jaw tag A4441 on October 27, 1987, at age 0, 7.0 in. A difficult pattern. “A” is surely a pond check, the first annulus is probably at “B” (possibly at “C”), the second annulus is probably at “D”, and “E” might be a fall check. Another possible interpretation, more consistent with relative lengths at tagging and recapture, is that the first annulus is at “D” and the second annulus is at “E”. Growth was poor because of jaw tag.

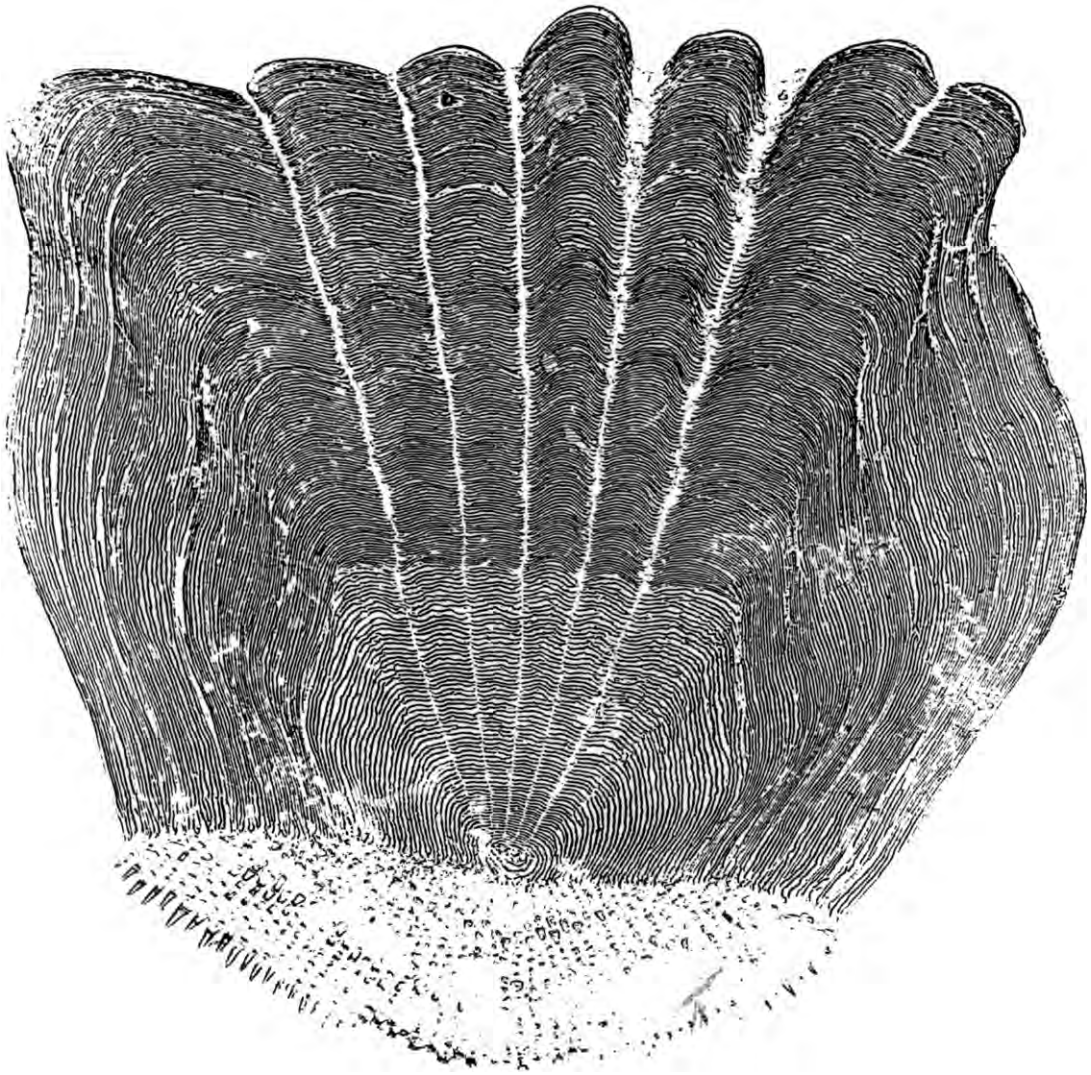


Figure 24.–Walleye; 18.3"; March 1990; Lake St. Clair; 20X.

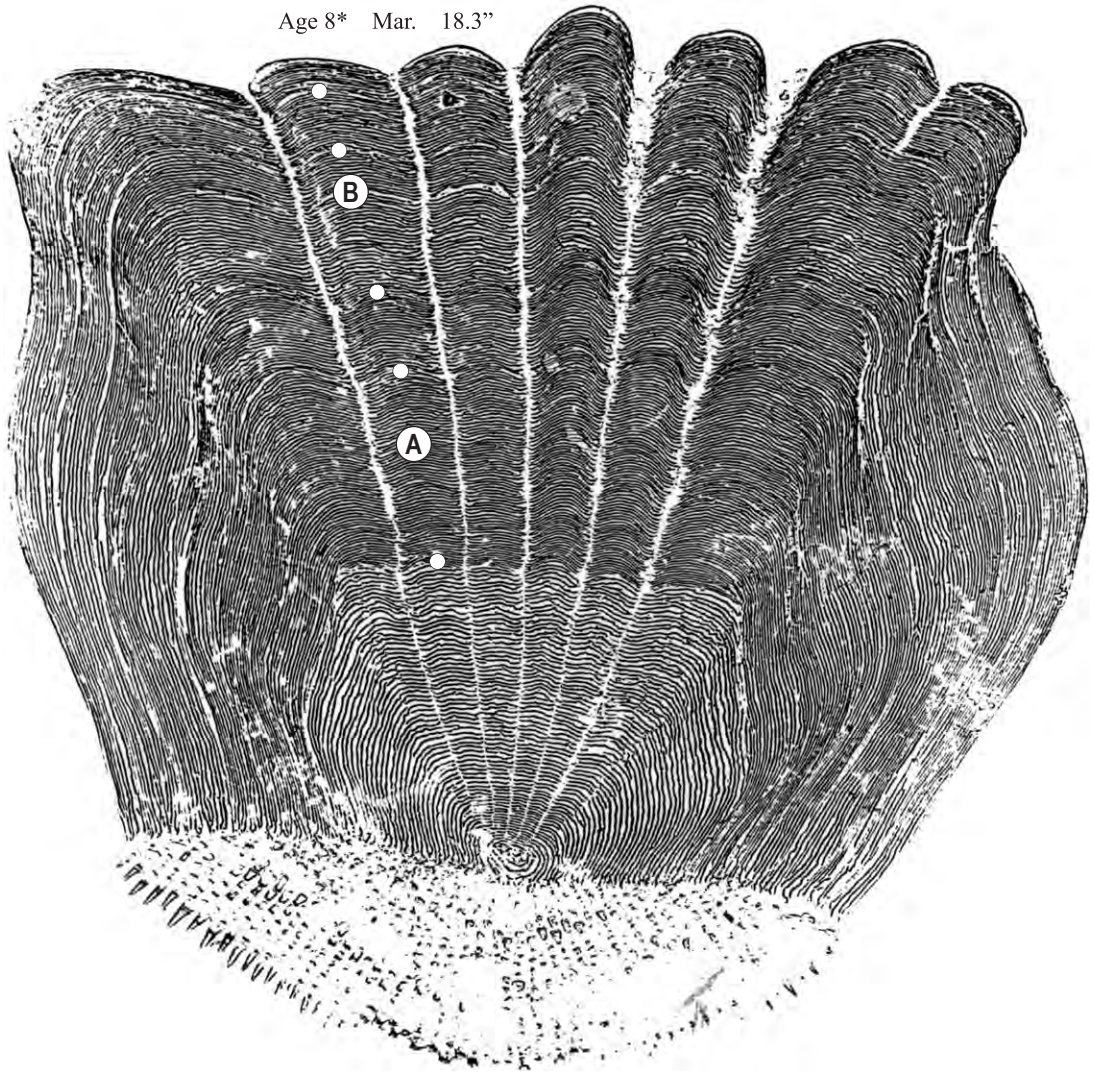


Figure 24.–Age 8* walleye. Issued jaw tag A2048 on October 24, 1983, at age 0, 7.8 in. Very difficult to age. The five dots mark fairly clear annuli, and “A” and “B” were thought to be checks at first glance. But we need a total of eight annuli (including the edge), so “A” and “B” must be annuli. (There may be, of course, two more completely unsuspected annuli on the edge - as in Figure 18).

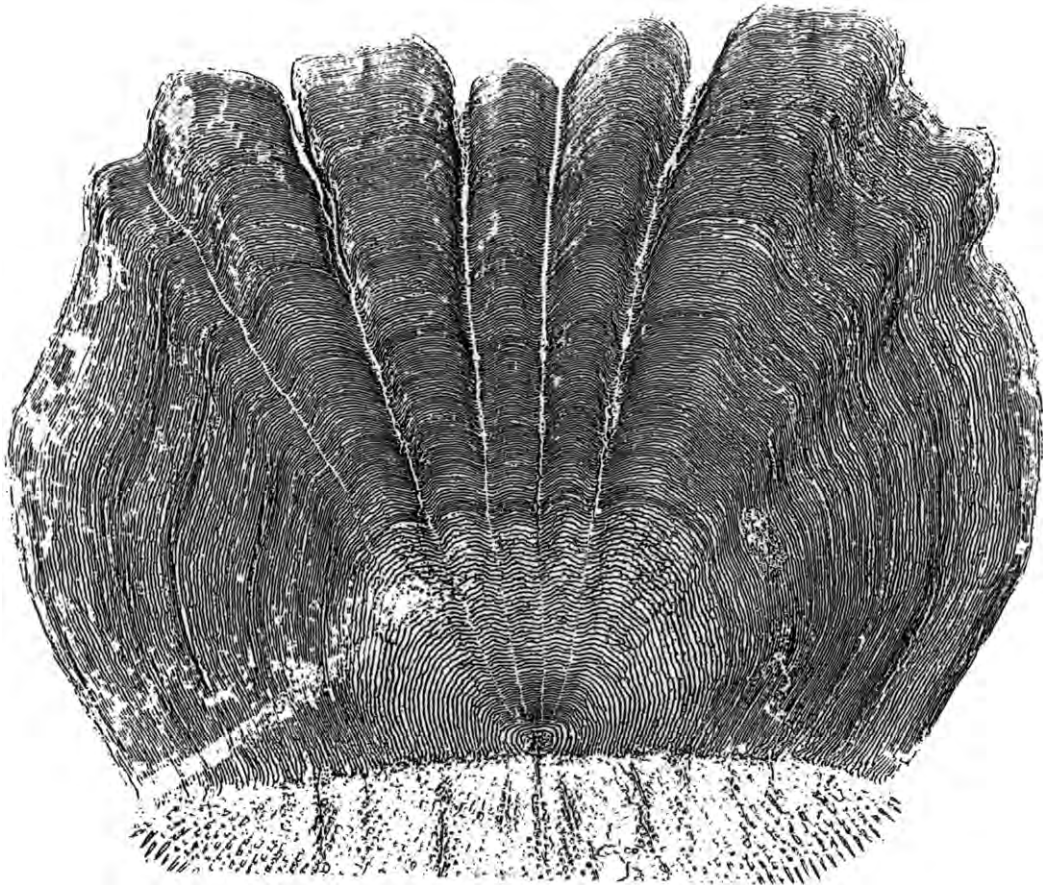


Figure 25.–Walleye; 21.3”; March 1990; Lake St. Clair; 20X.

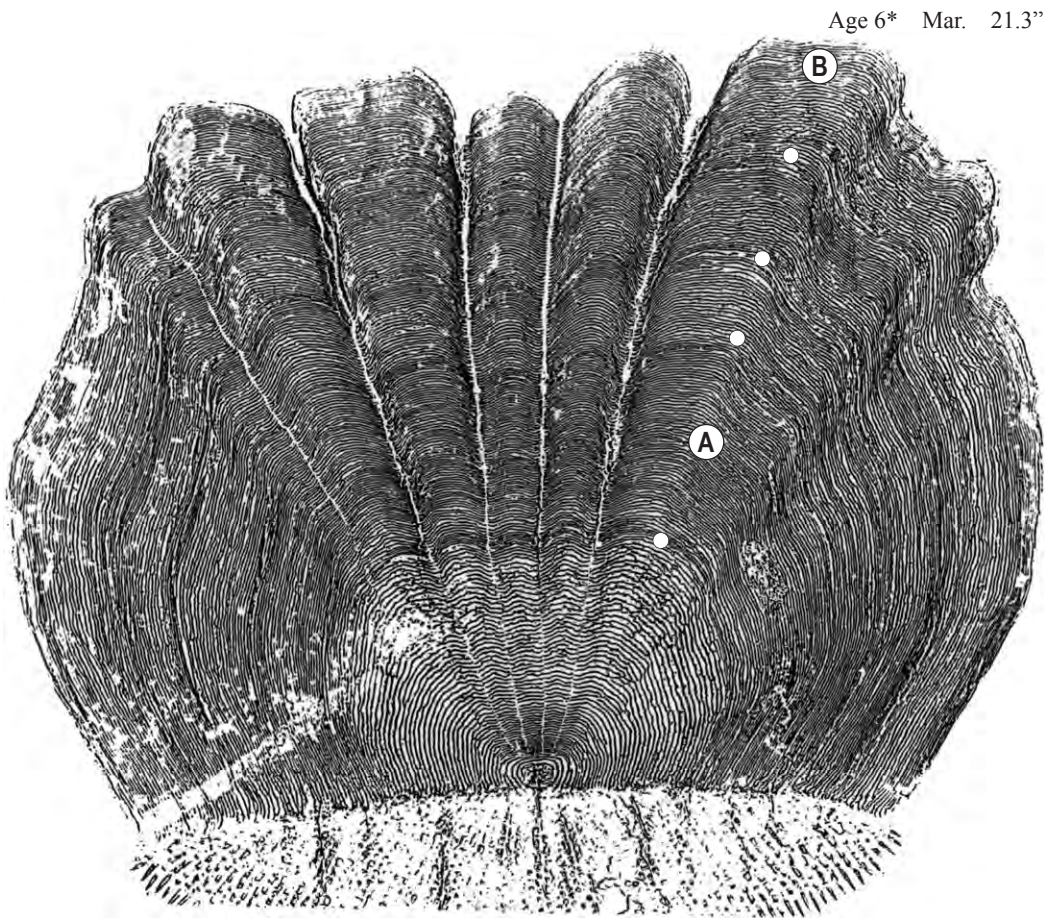


Figure 25.–Age 6* walleye. Issued jaw tag A2463 on October 17, 1984, at age 0, 8.6 in. The dots mark the obvious annuli, and “A” and “B” are other possibilities - one of which must be real. “A” appears to be the stronger candidate, but it is not as clearly defined as the second annuli on most walleyes.

Figure 26a.–Yellow perch; 4.2”; October 1971; Saline Ponds; 27X.

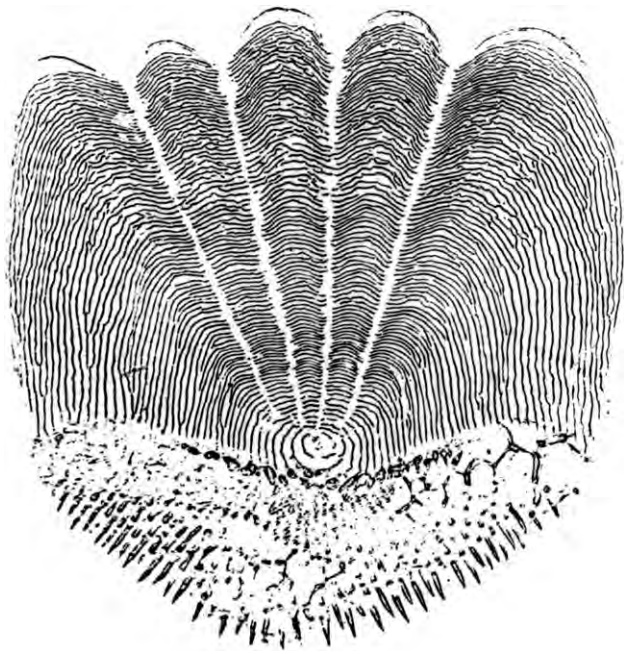


Figure 26b.–Yellow perch; 5.9”; October 1971; Saline Ponds; 27X.

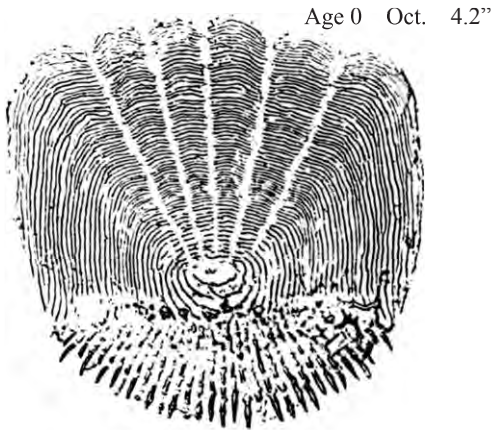


Figure 26a.–Age 0 yellow perch. Larger than most young-of-the-year in lakes, but a smaller member of its pond cohort.

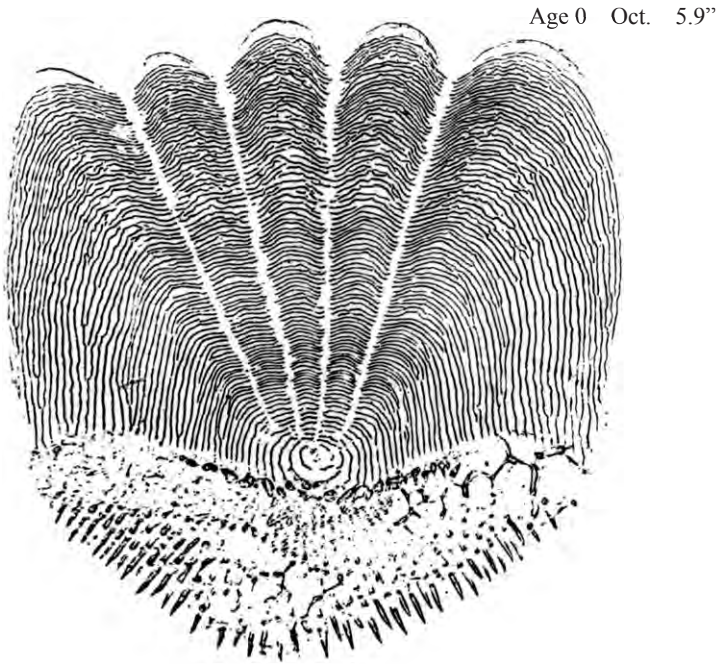


Figure 26b.–Age 0 yellow perch. Note check caused by increased growth, probably due to change in diet.

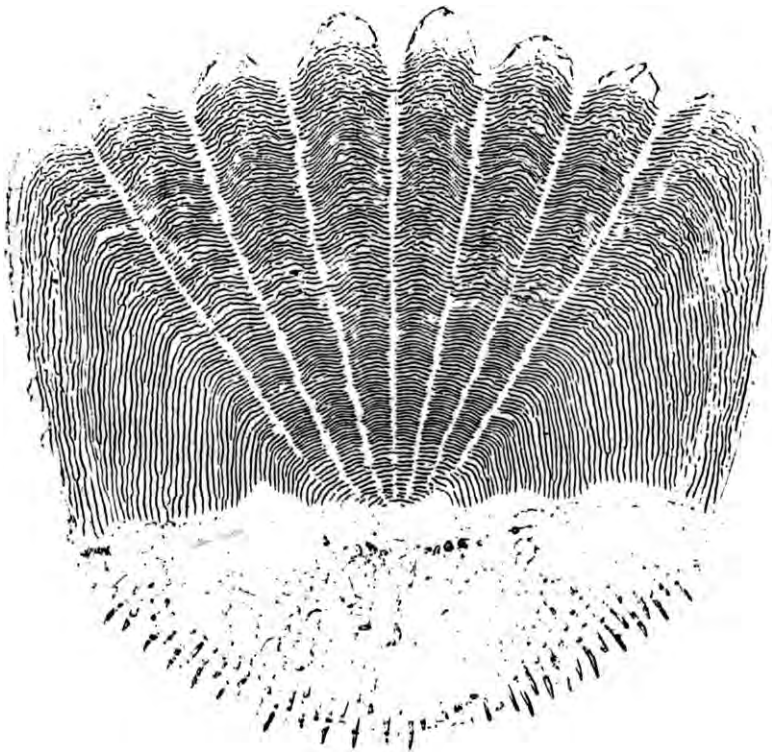


Figure 27.–Yellow perch; 7.2"; October 1970; Saline Ponds; 27X.

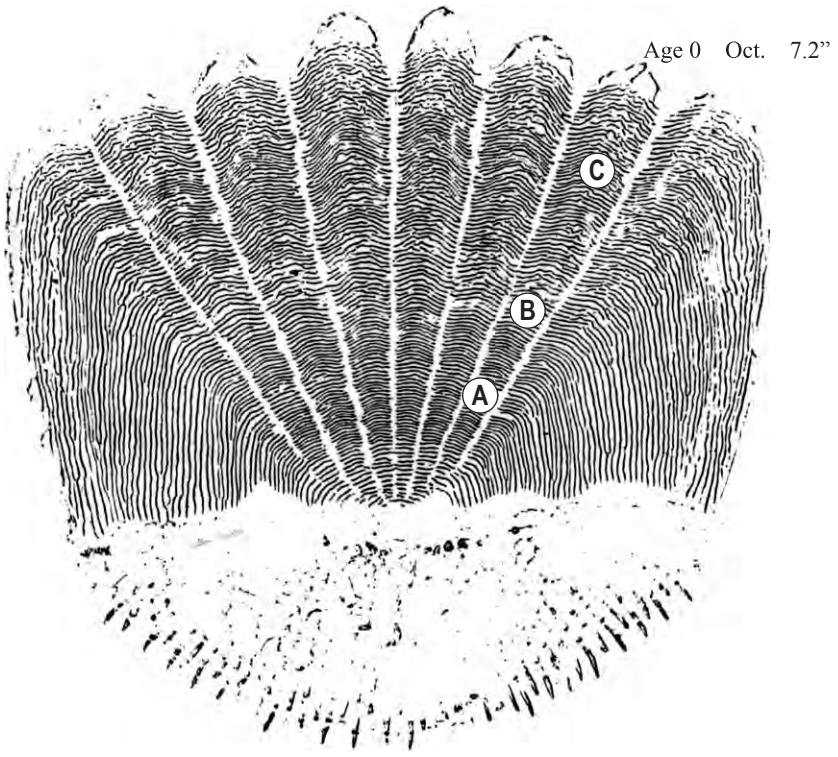


Figure 27.–Age 0 yellow perch. The largest fish in its cohort. Note checks at “A”, “B”, and “C” due to growth rate changes. Spurt of growth in fall may be due to availability of crayfish in these ponds.

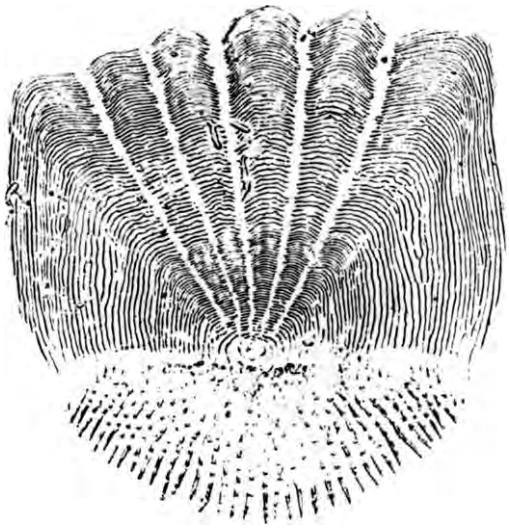


Figure 28a.–Yellow perch; 5.1”; October 1971; Saline Ponds; 27X.

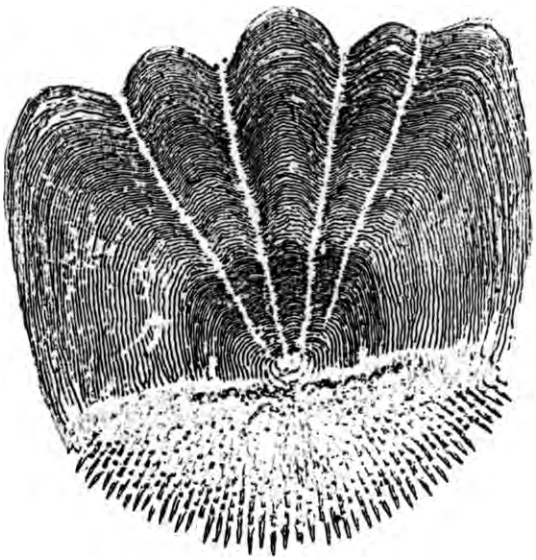


Figure 28b.–Yellow perch; 6.8”; October 1971; Saline Ponds; 27X.

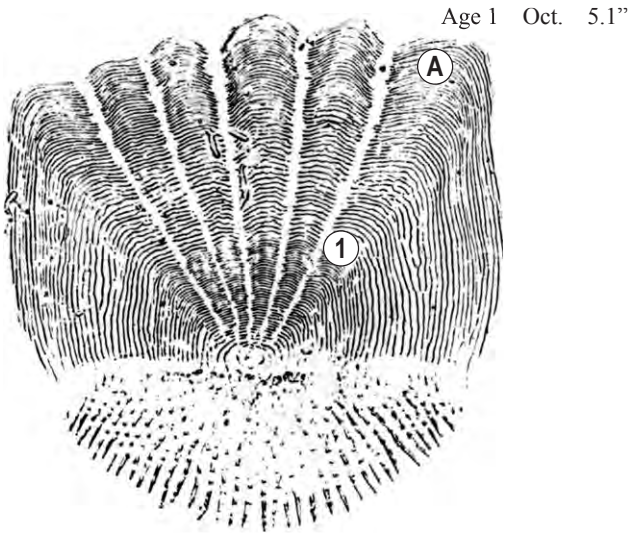


Figure 28a.–Age 1 yellow perch. Stocked into pond at first annulus. Note check with crossing over at “A”, formed in fall.

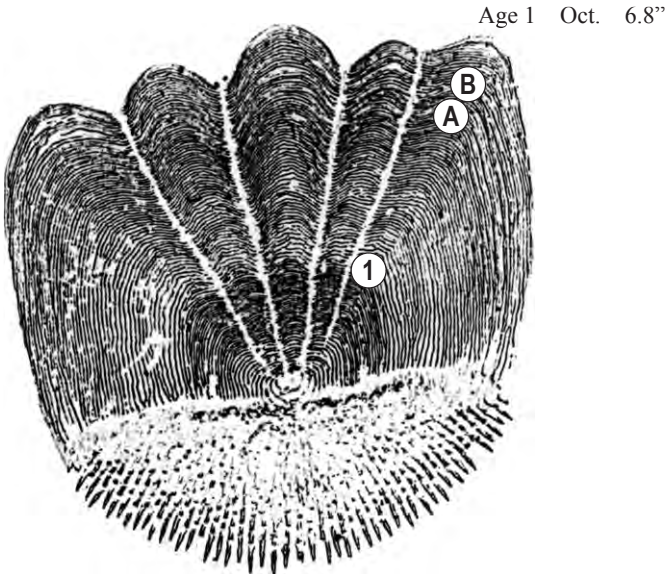


Figure 28b.–Age 1 yellow perch. Stocked into pond at first annulus. Checks “A” and “B” are so strong near edge that most readers would believe this is a stunted age 3.

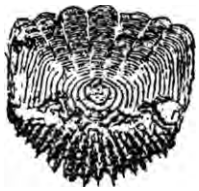


Figure 29a.–Yellow perch; 2.4”; October 1965; Cassidy Lake; 27X.

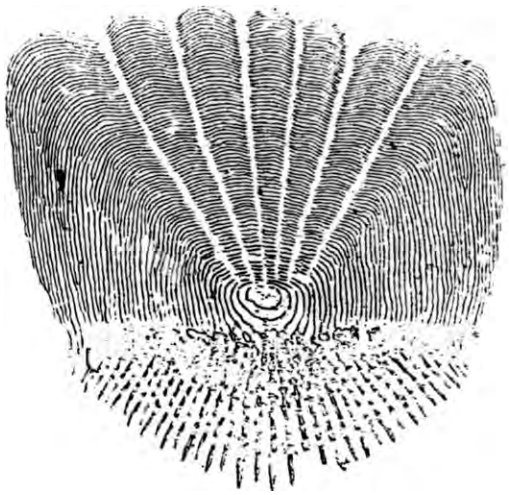


Figure 29b.–Yellow perch; 5.1”; October 1965; Cassidy Lake; 27X.

Figure 29a.–Age 0 yellow perch. The smallest member of the dominant cohort in Cassidy Lake.

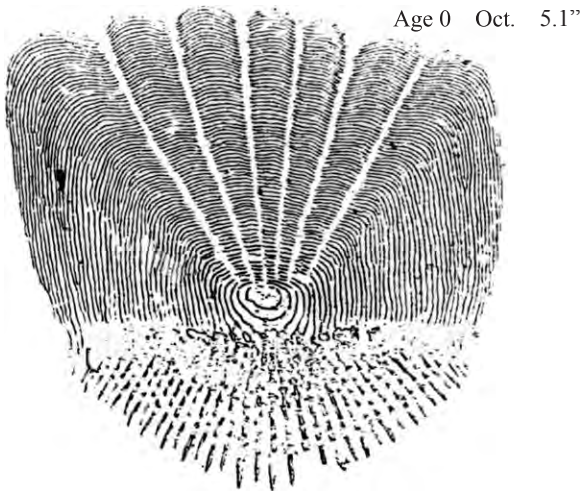


Figure 29b.–Age 0 yellow perch. The largest member of the cohort. Easy, no checks.

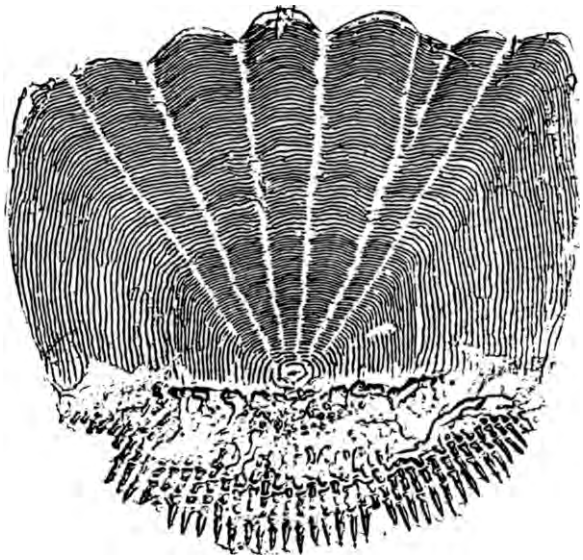


Figure 30a.–Yellow perch; 5.7”; October 1965; Cassidy Lake; 27X.

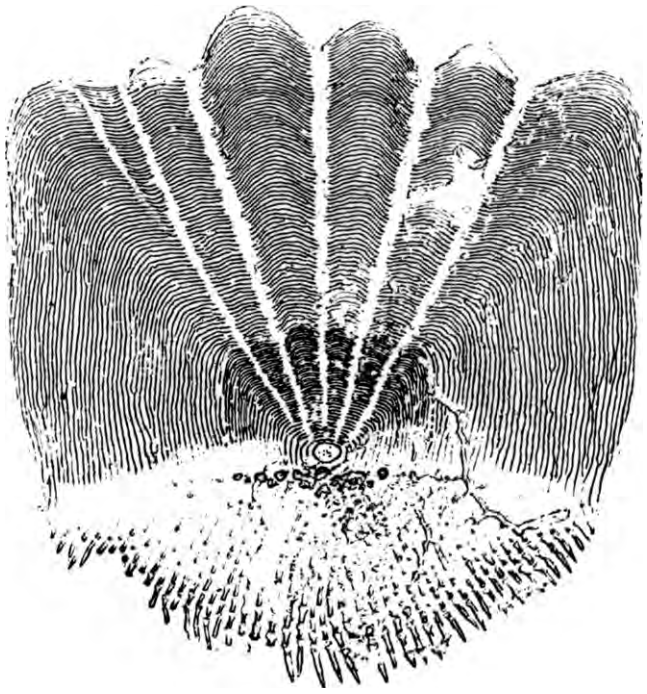


Figure 30b.–Yellow perch; 7.9”; October 1965; Cassidy Lake; 27X.

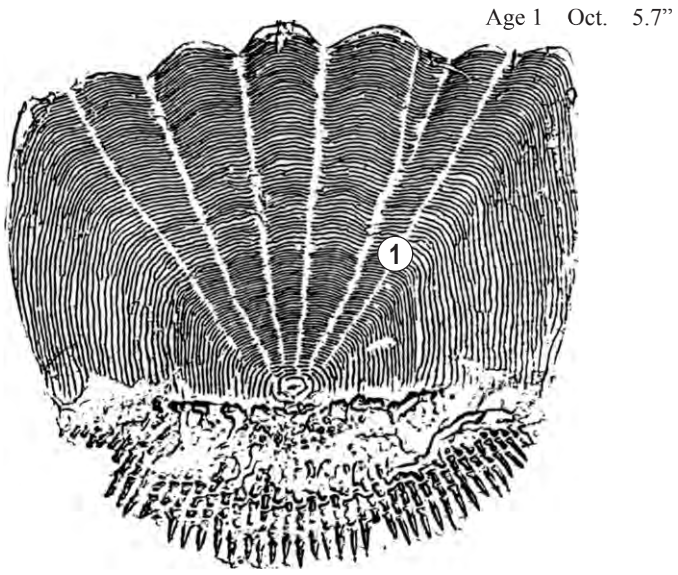


Figure 30a.–Age 1 yellow perch. Stocked in Cassidy Lake in spring of age 1.

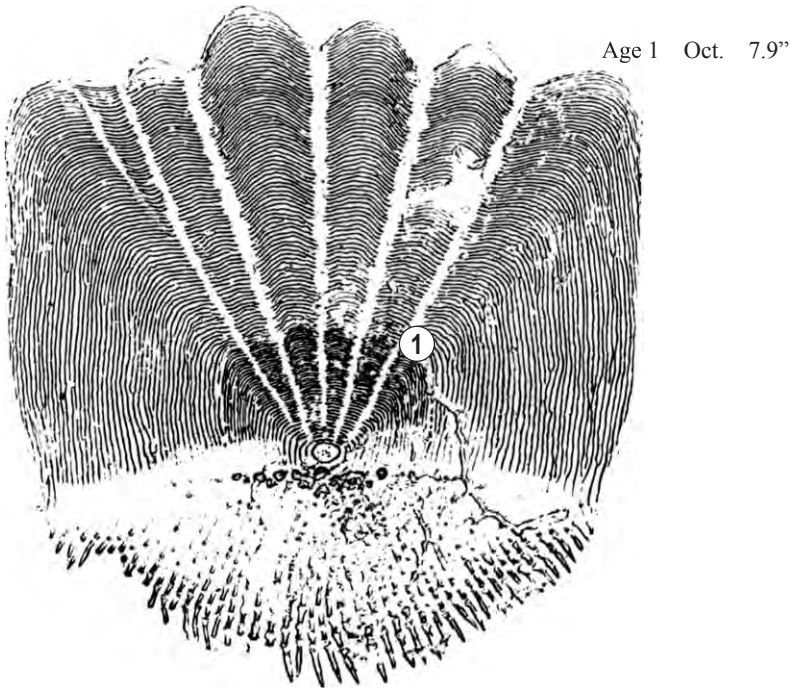


Figure 30b.–Age 1 yellow perch. Also stocked in spring of age 1, but took full advantage of the release from competition following rotenone treatment in 1964.

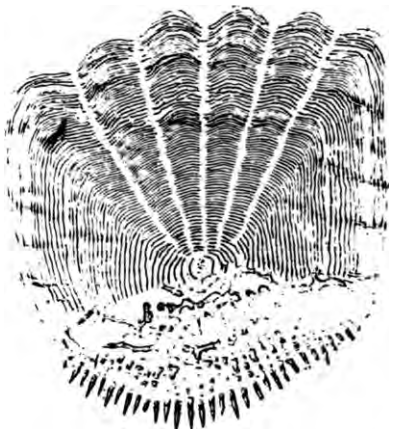


Figure 31a.–Yellow perch; 4.1”; May 1968; Cassidy Lake; 27X.

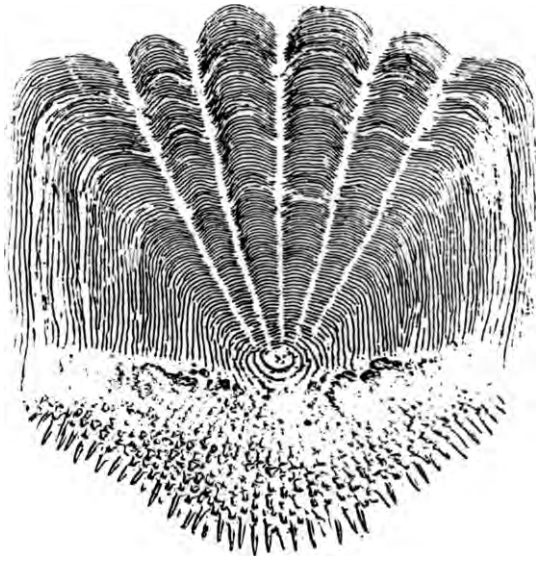


Figure 31b.–Yellow perch; 5.5”; female; March 1969; Cassidy Lake; 27X.

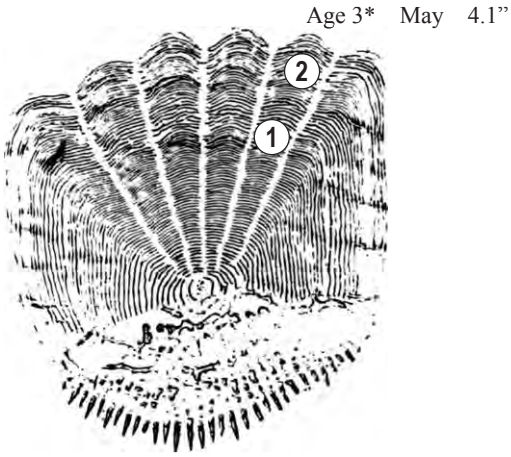


Figure 31a.–Age 3* yellow perch. Stunted after first growing season in Cassidy Lake, and might even guess 4*. Note resorbtion.

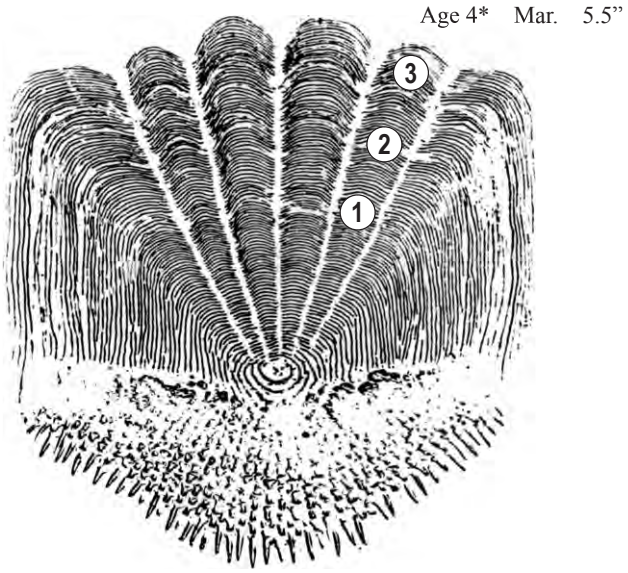


Figure 31b.–Age 4* yellow perch. Might guess 5*.

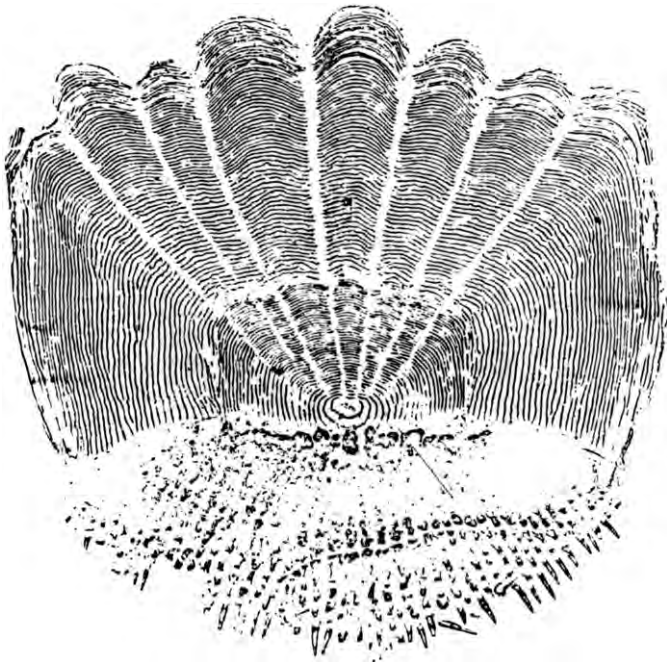


Figure 32.–Yellow perch; 7.0”; May 1968; Cassidy Lake; 27X.

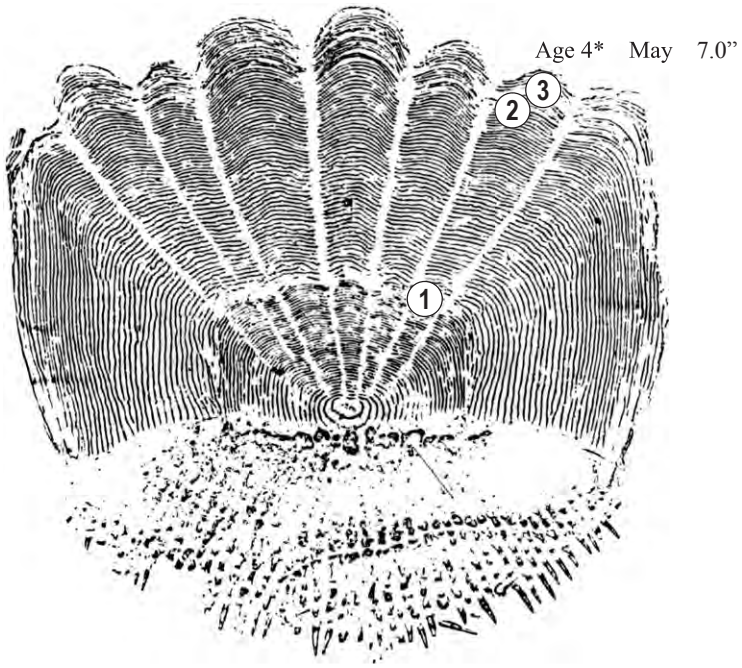


Figure 32.–Age 4* yellow perch. Stocked into Cassidy Lake as a yearling, grew rapidly in 1965 because of low competition, then quit growing. Much resorption evident.

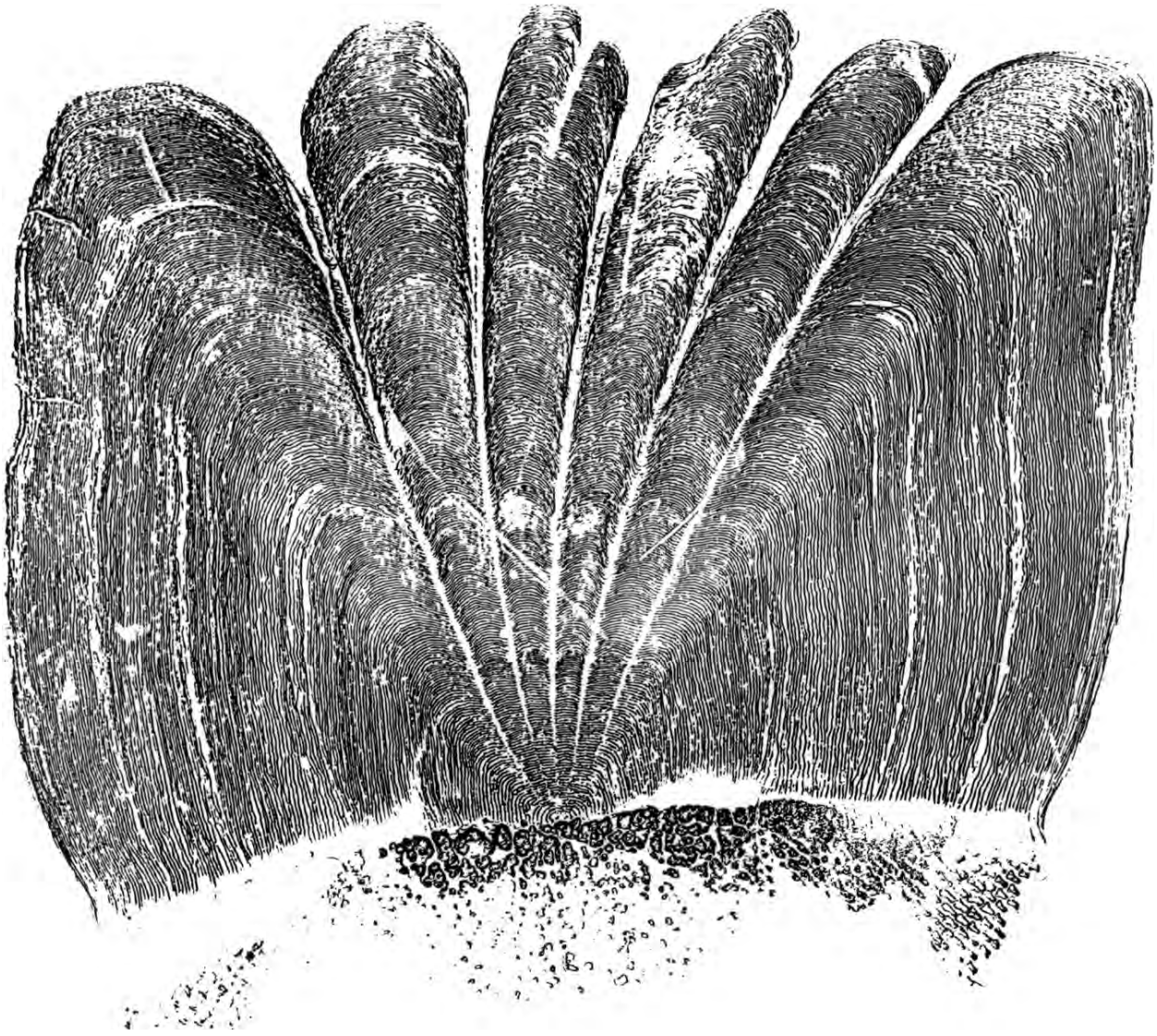


Figure 33.–Yellow perch; 13.5”; female; April 1969; Cassidy Lake; 20X.

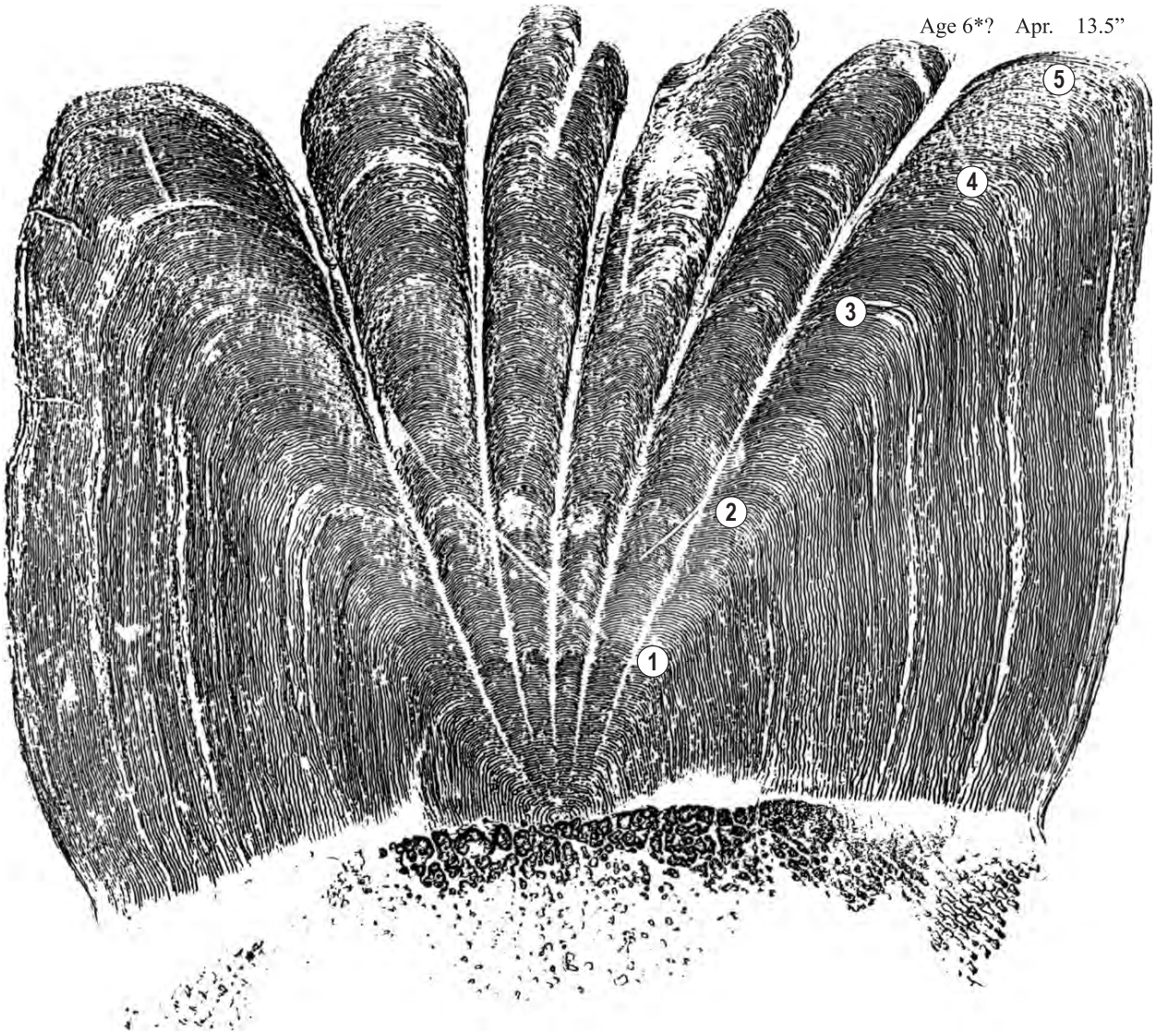


Figure 33.–Yellow perch, probably age 6*. A clear pattern. Fish large enough to be cannibalistic continued to grow in Cassidy Lake while smaller perch, competing for invertebrates, stunted. Probably stocked as age 2 in spring of 1965.

Figure 34a.–Yellow perch; 4.5”; October 1976; Jewett Lake; 27X.

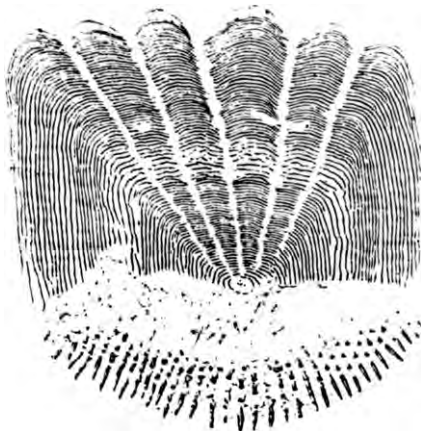


Figure 34b.–Yellow perch; 4.4”; October 1976; Jewett Lake; 27X.

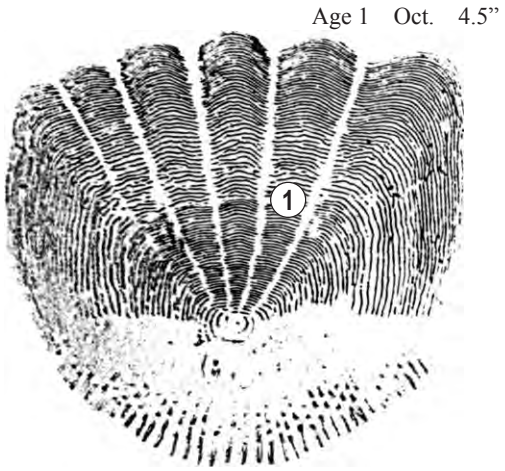


Figure 34a.–Age 1 yellow perch. Clear and typical pattern for Jewett Lake at this time.

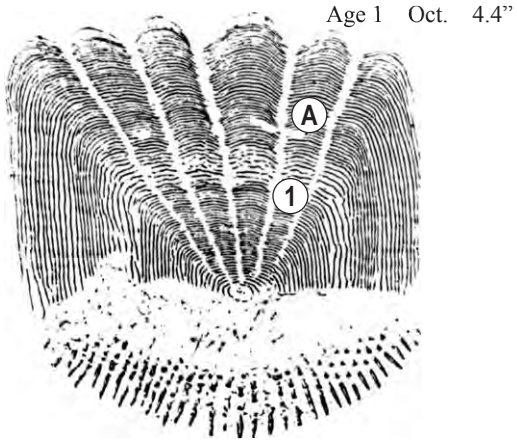


Figure 34b.–Age 1 yellow perch. A very weak check in second season due to growth spurt at “A”.

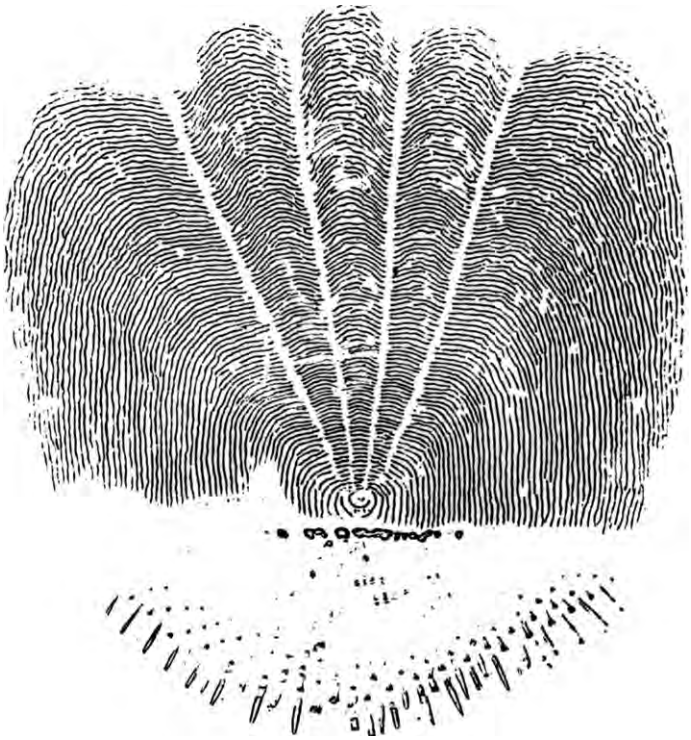


Figure 35a.–Yellow perch; 7.0”; September 1975; Jewett Lake; 27X.

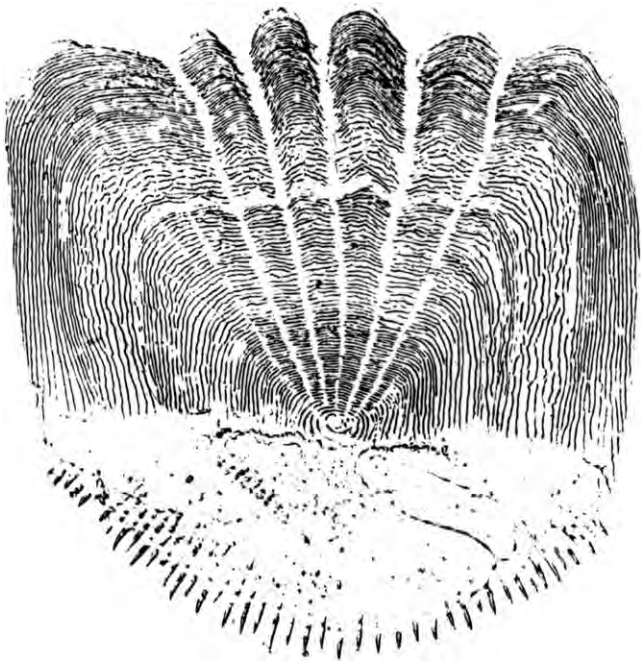


Figure 35b.–Yellow perch; 6.7”; October 1976; Jewett Lake; 27X.

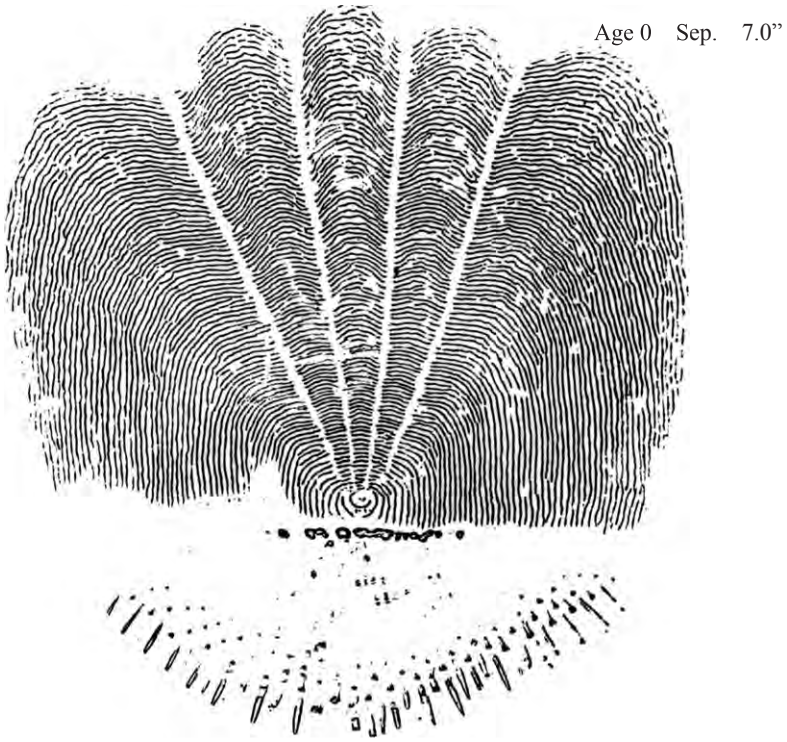


Figure 35a.–Age 0 yellow perch. An extremely fast grower with no checks. Jewett Lake contained few competitors at this time.

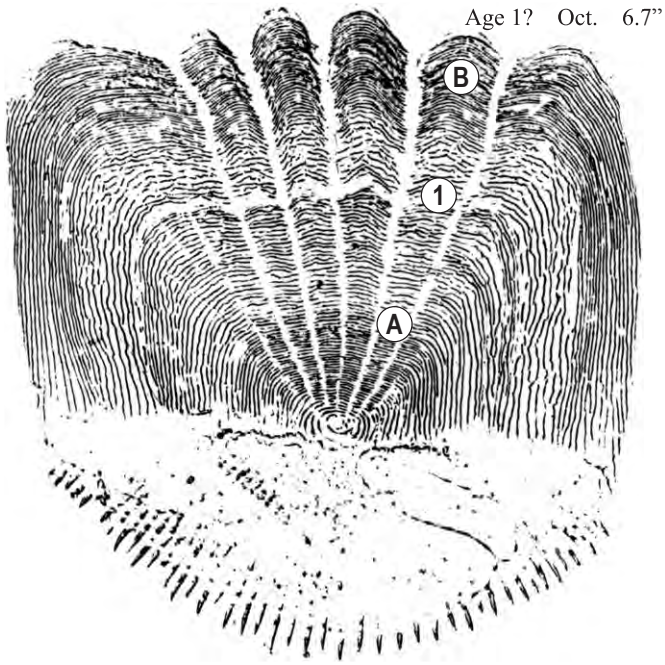


Figure 35b.–Yellow perch, probably age 1. Believed to have been stocked in Jewett Lake as an egg in 1975. Interpretation of checks at “A” and “B” takes into account fast growth shown by other fish in these years.

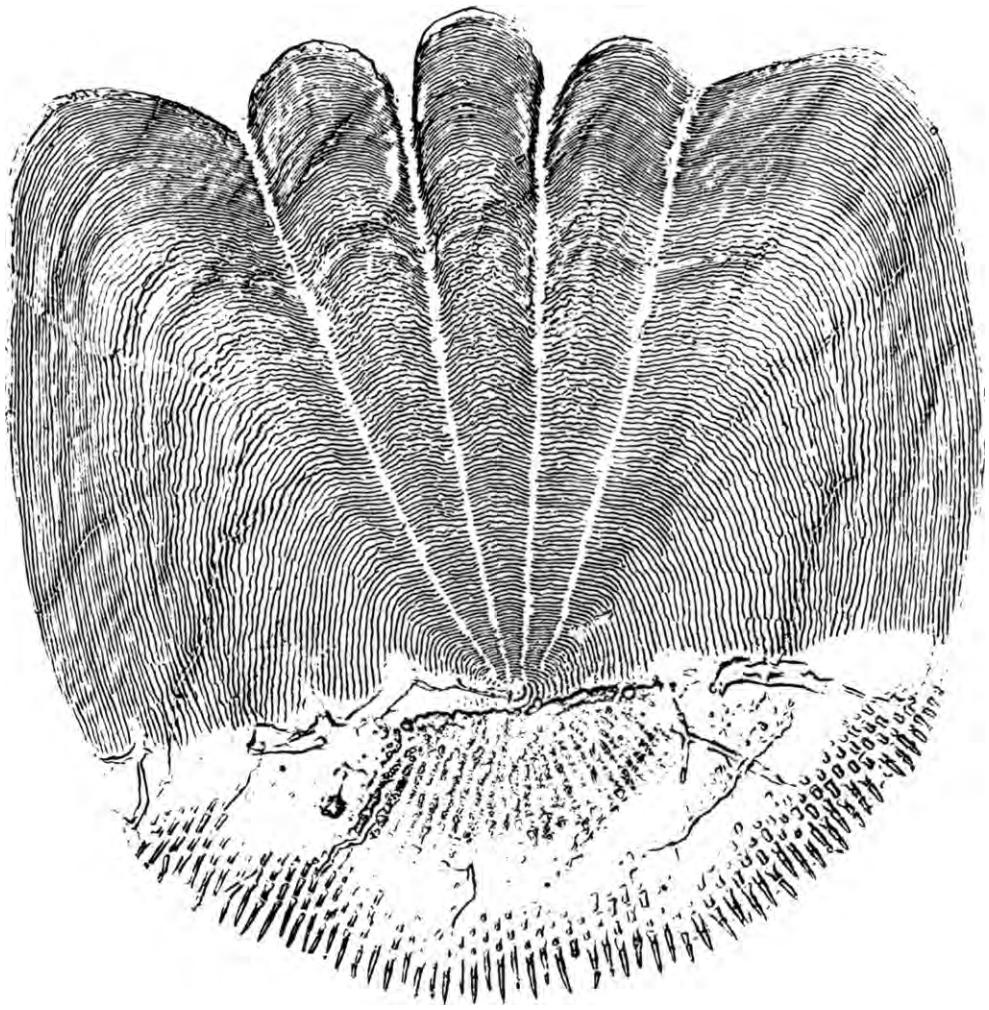


Figure 36.–Yellow perch; 10.2”; October 1976; Jewett Lake; 27X.

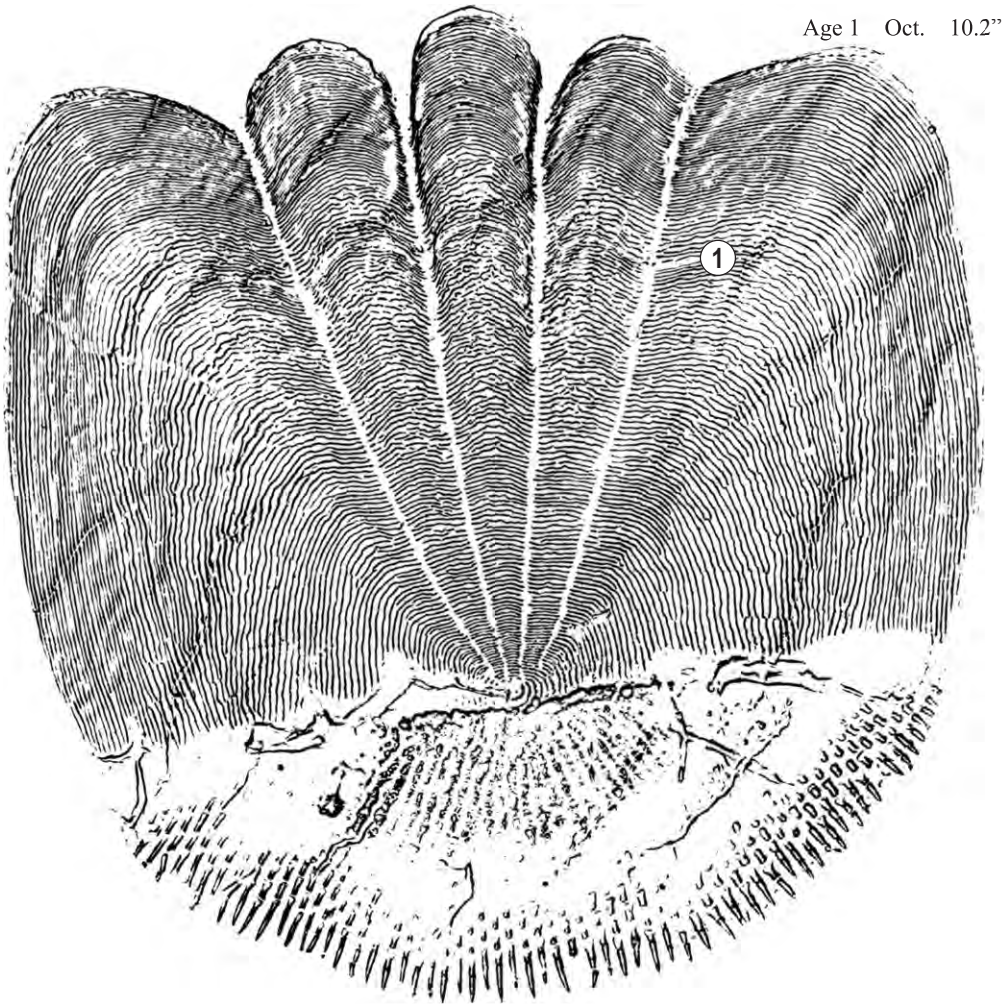


Figure 36.–Age 1 yellow perch. A fast grower in Jewett Lake.

Figure 37a.–Yellow perch; 3.5”; May 10, 1989; Blueberry Lake; 27X.

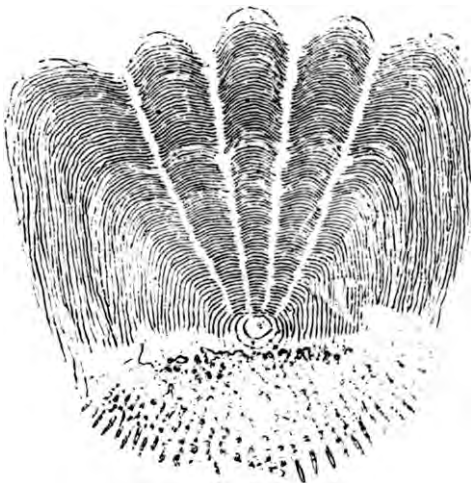


Figure 37b.–Yellow perch; 4.8”; March 1989; Blueberry Lake; 27X.

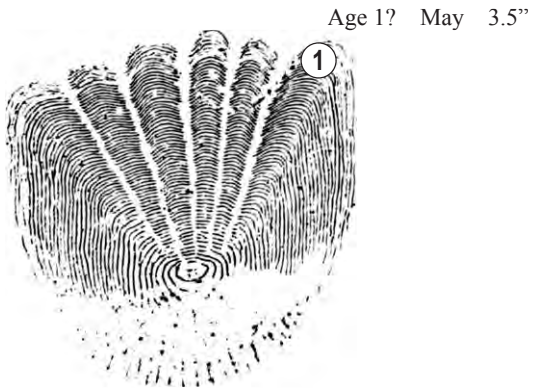


Figure 37a.–Yellow perch, probably age 1. Ages of perch not definitely known for Blueberry Lake (Figures 37-41). This is a typical yearling which already on May 10 shows new growth.

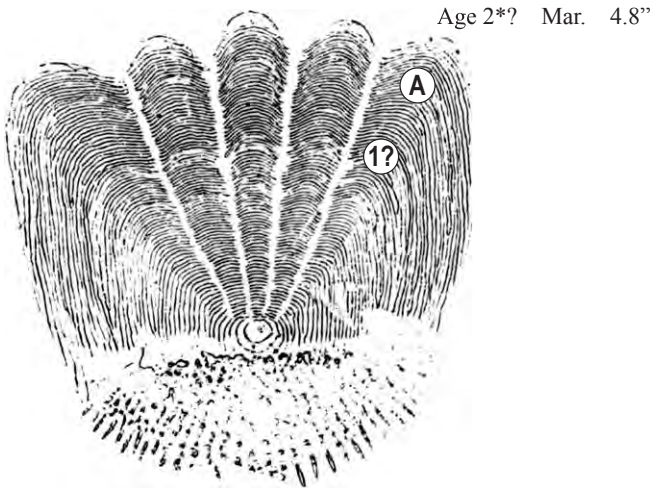


Figure 37b.–Yellow perch, probably age 2*. Note a check and some crossing over at “A” during the second season.

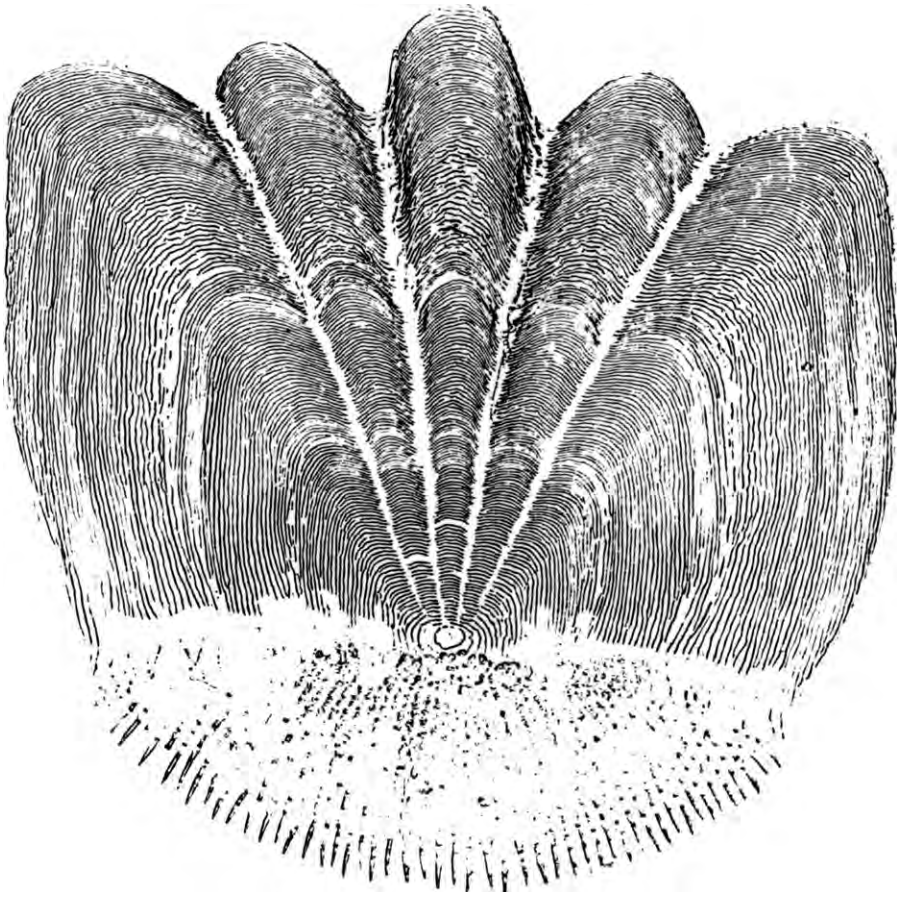


Figure 38.–Yellow perch; 8.8”; March 1989; Blueberry Lake; 27X.

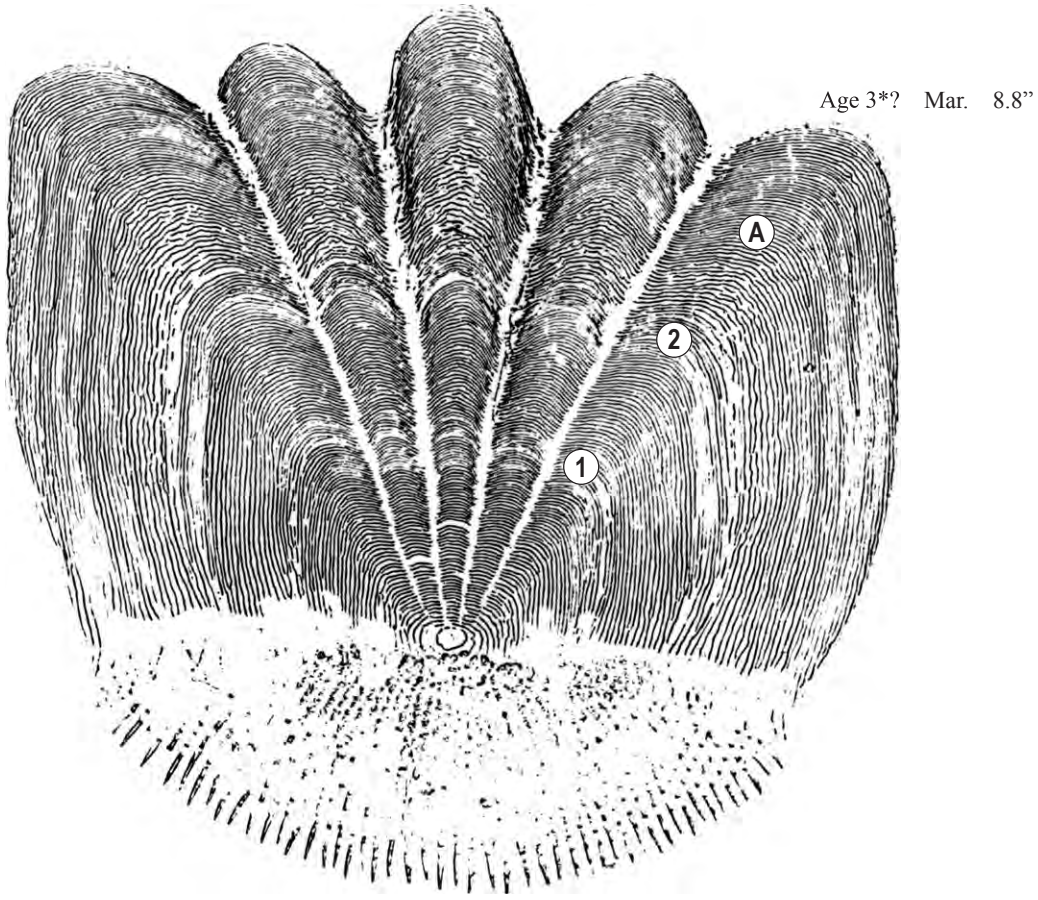


Figure 38.–Yellow perch, probably age 3*. Ages of perch in Blueberry Lake are not known for sure, but there is little doubt about this one. Note slight check at “A”, corresponding to the summer of the third season, and the following spurt of fall growth.

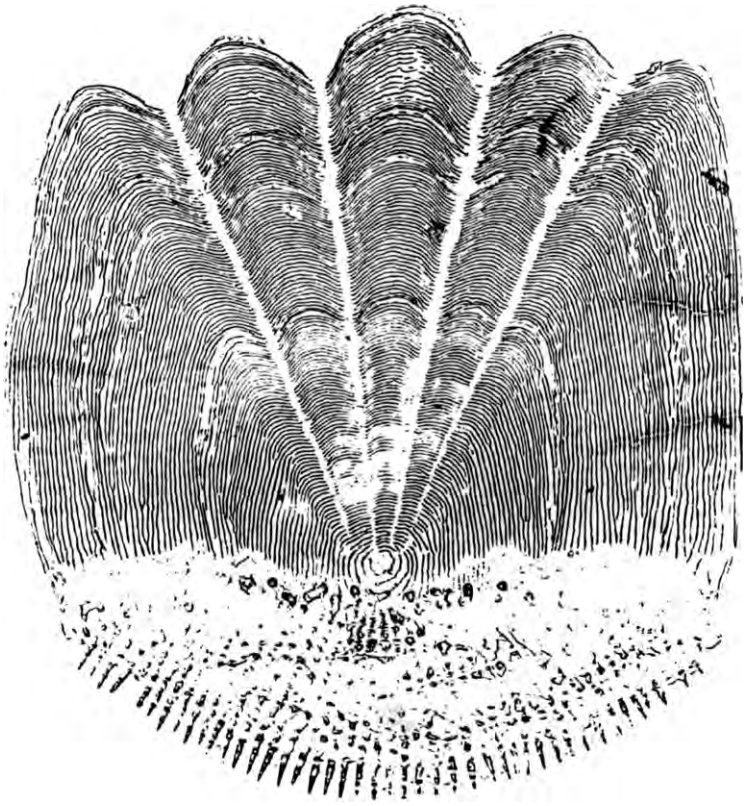


Figure 39.–Yellow perch; 8.1"; March 1989; Blueberry Lake; 27X.

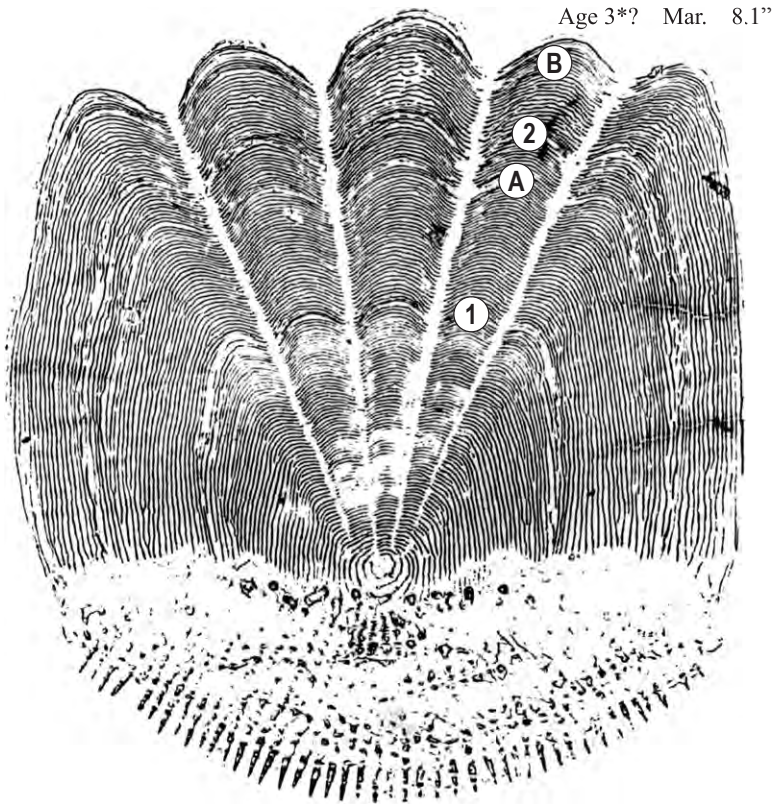


Figure 39.–Yellow perch, probably age 3, but age not confirmed. An unusual pattern interpreted as fall checks at “A” and “B”. Alternative interpretations are 5*, or 4* with one check.

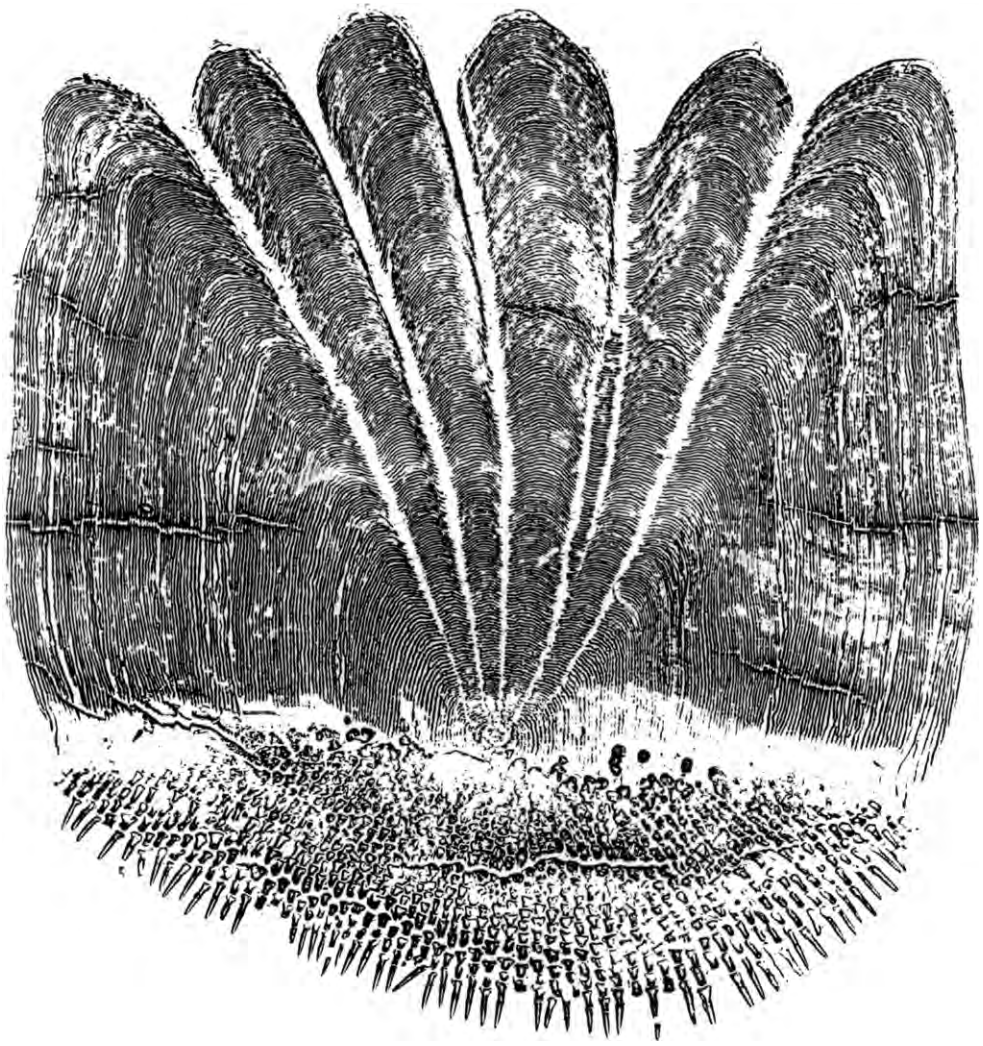


Figure 40.–Yellow perch; 8.8"; October 1964; Saginaw Bay; 27X.

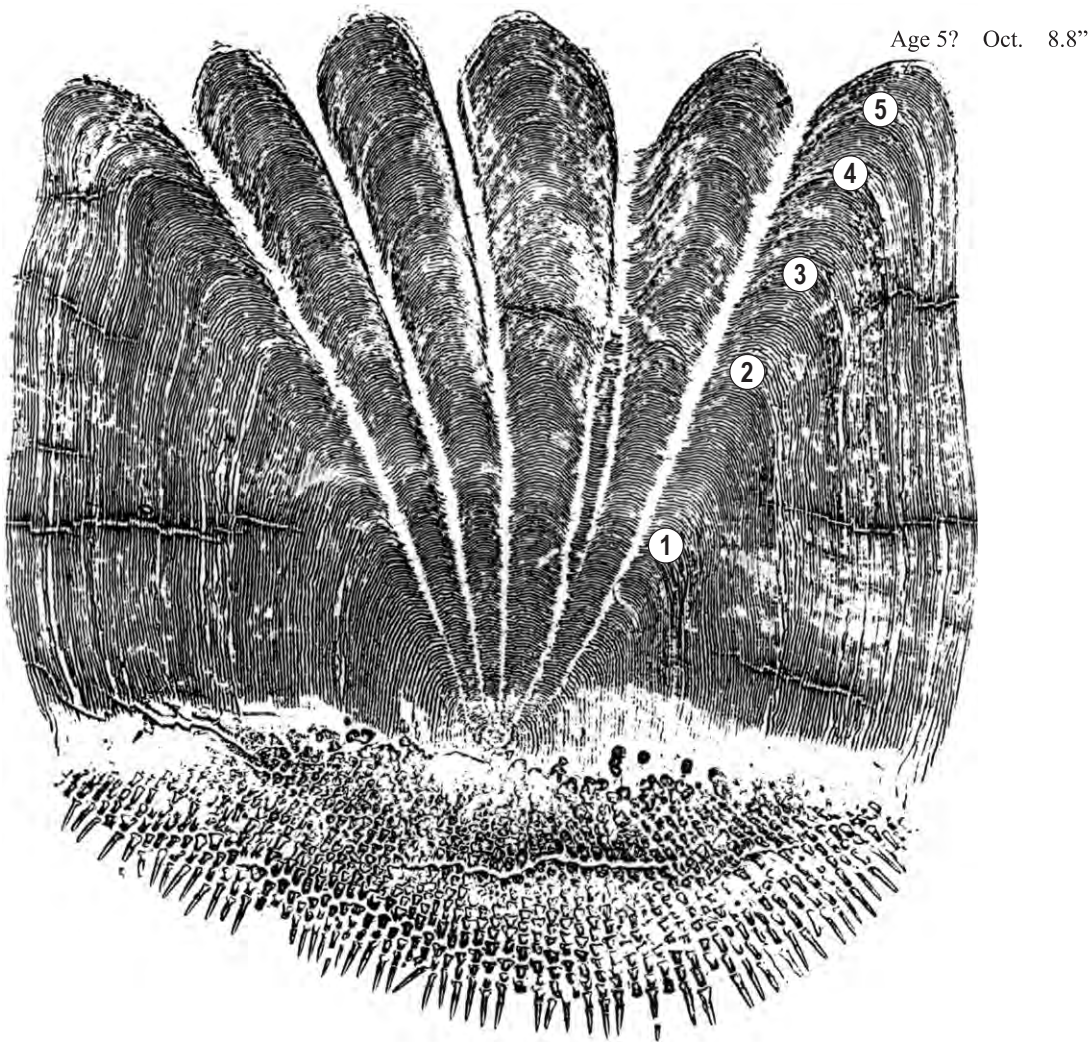


Figure 40.–Yellow perch, probably age 5, but not confirmed. One of the clearer patterns in a perch population which is hard to age. Crossing over is clear on this scale.

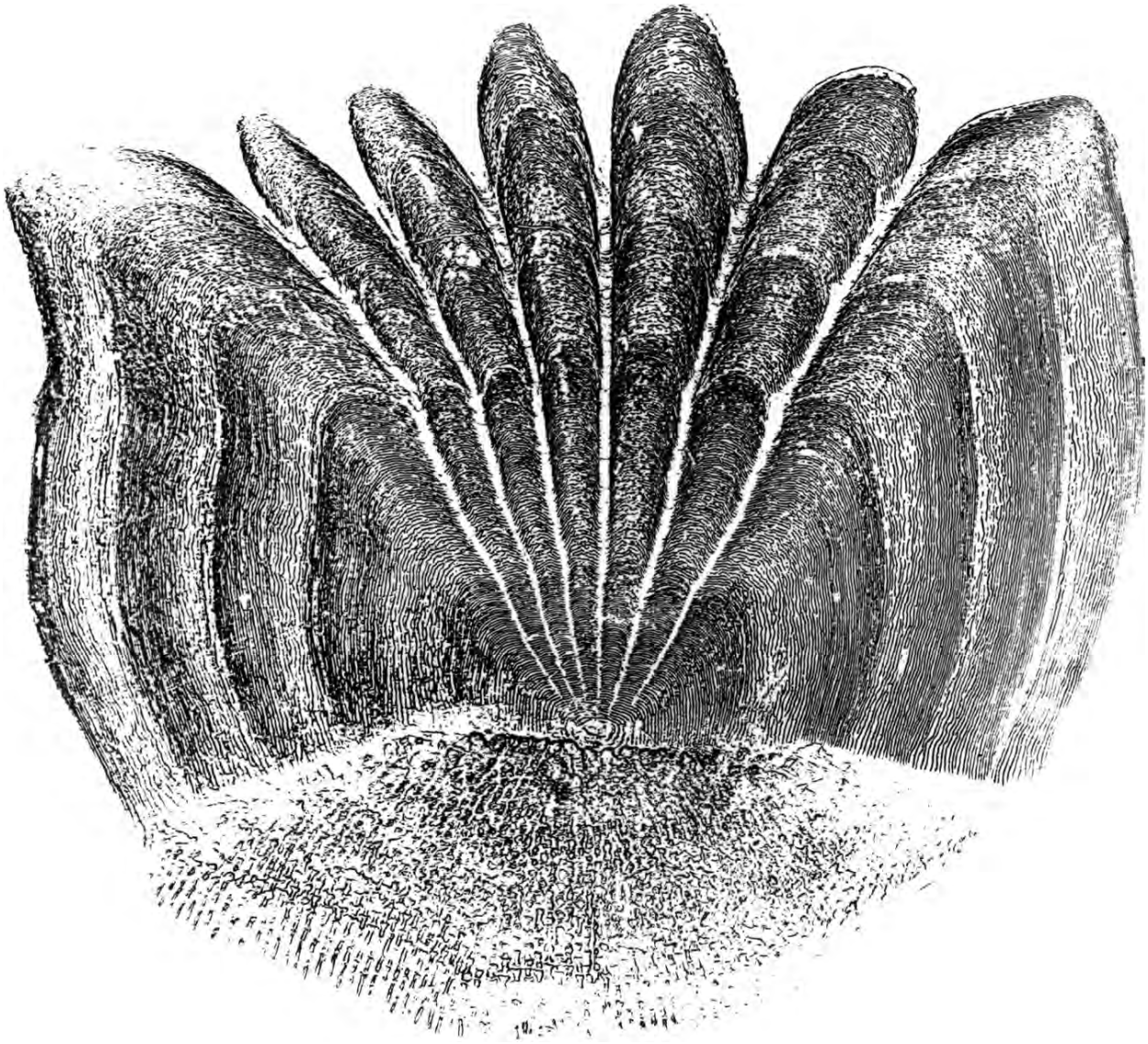


Figure 41.–Yellow perch; 10.5”; female; May 1975; Lake St. Clair; 20X.

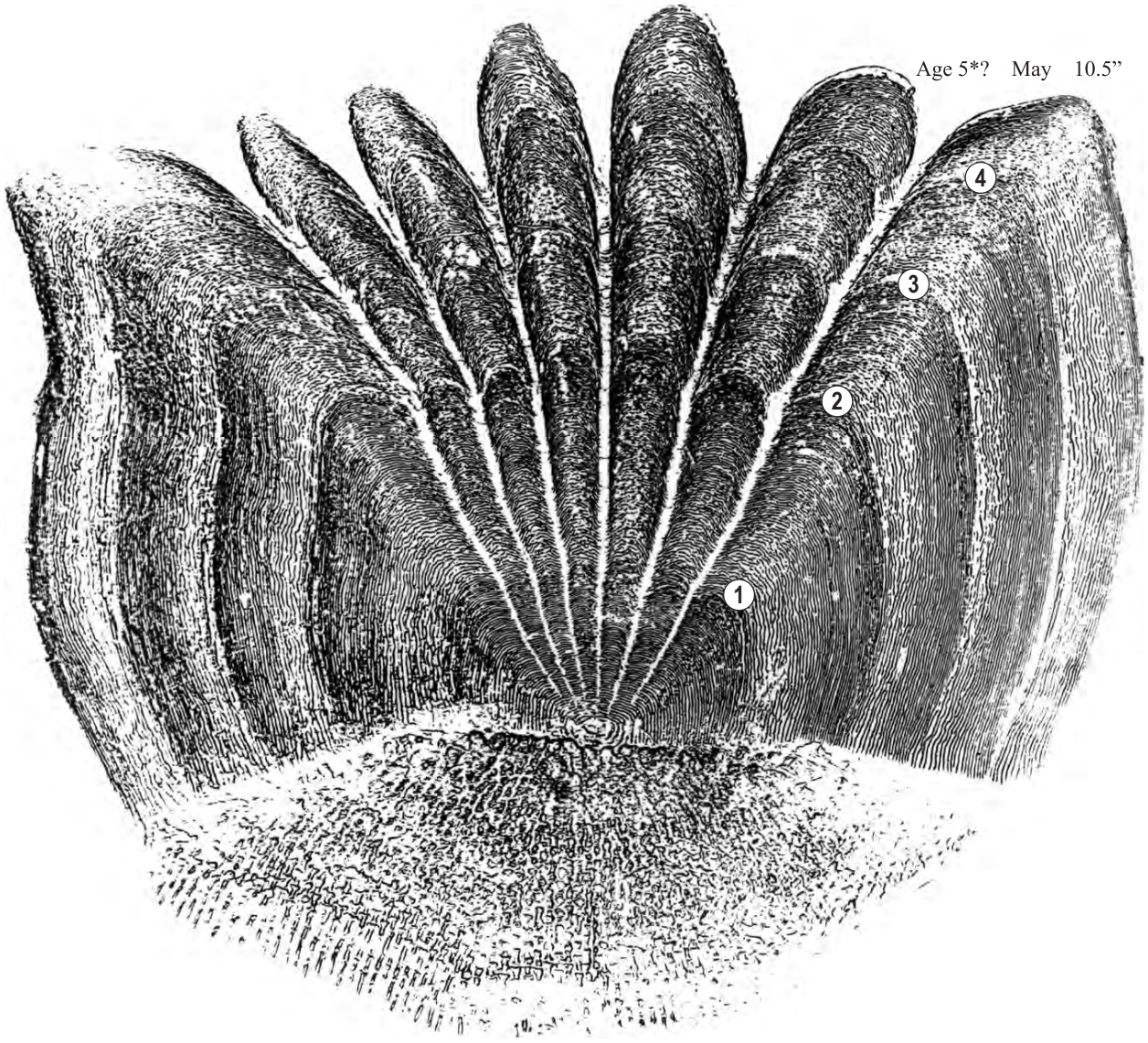


Figure 41.–Yellow perch, probably age 5*. As clear, uniform, checkless, and classical a pattern as a tired scale reader could hope for. Not all Lake St. Clair perch are this easy.

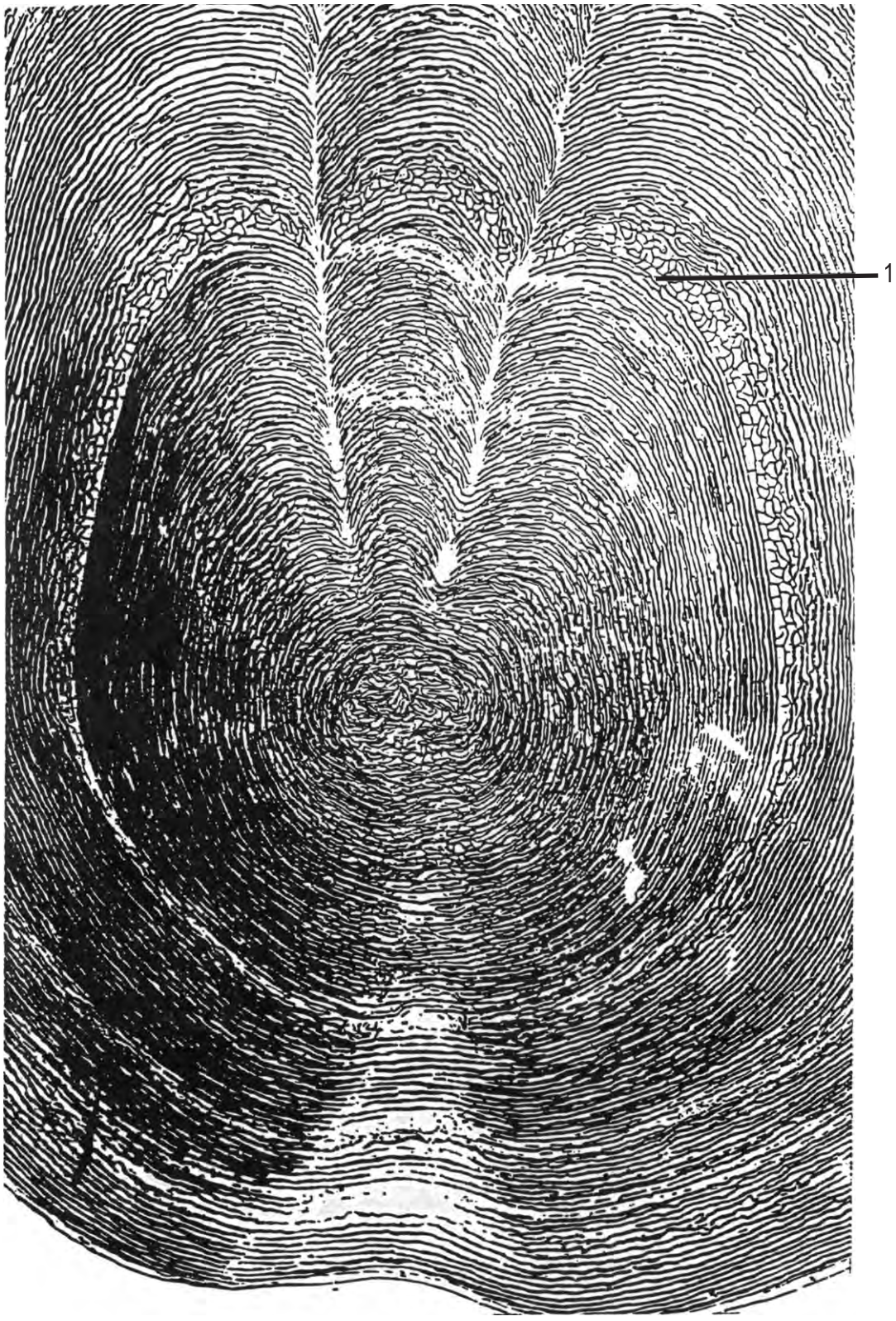


Figure 42.–A typical first annulus (1) on a scale from a 19.2-inch pike collected at Shingle Lake, Clare County on July 18, 1954. Note the chain-like pattern of the rapid scale growth after the annulus. 51.3X. (Figure 10 of Williams 1955).

Figure 43.–Annulus formation and new scale growth without corresponding increase in fish length. 28X. (Figure 11 of Williams 1955).

A. Scale from male pike (tag 12211) collected April 13, 1940 while migrating upstream to spawn at Houghton Lake. Total length 339 mm. Annulus beginning to form at anterior edge.

B. Scale from same pike collected June 4, 1940 while migrating downstream after spawning. Total length 339 mm. Annulus well in from edge, followed by considerable new, slow growth.

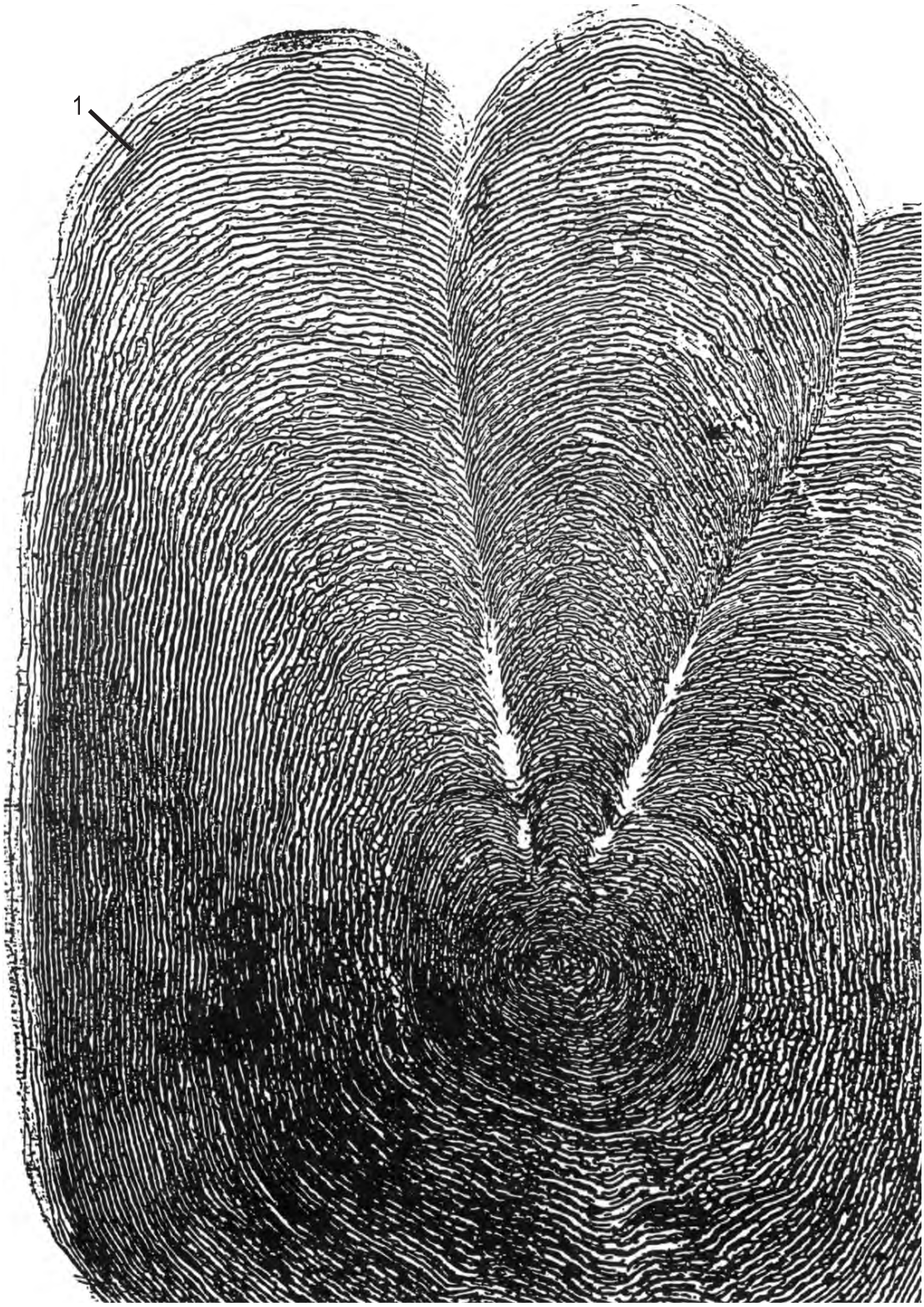


Figure 44.–Scale from a yearling, known-age pike (tag 37969) at Drayton Plains Hatchery on May 3, 1951. Fish was 13.8 inches in length and the first annulus has just formed near the margin. This pike measured 13.3 inches in length on October 13, 1950 and there were no marks near the edge of the scale on that date. (Figure 21 of Williams 1955).

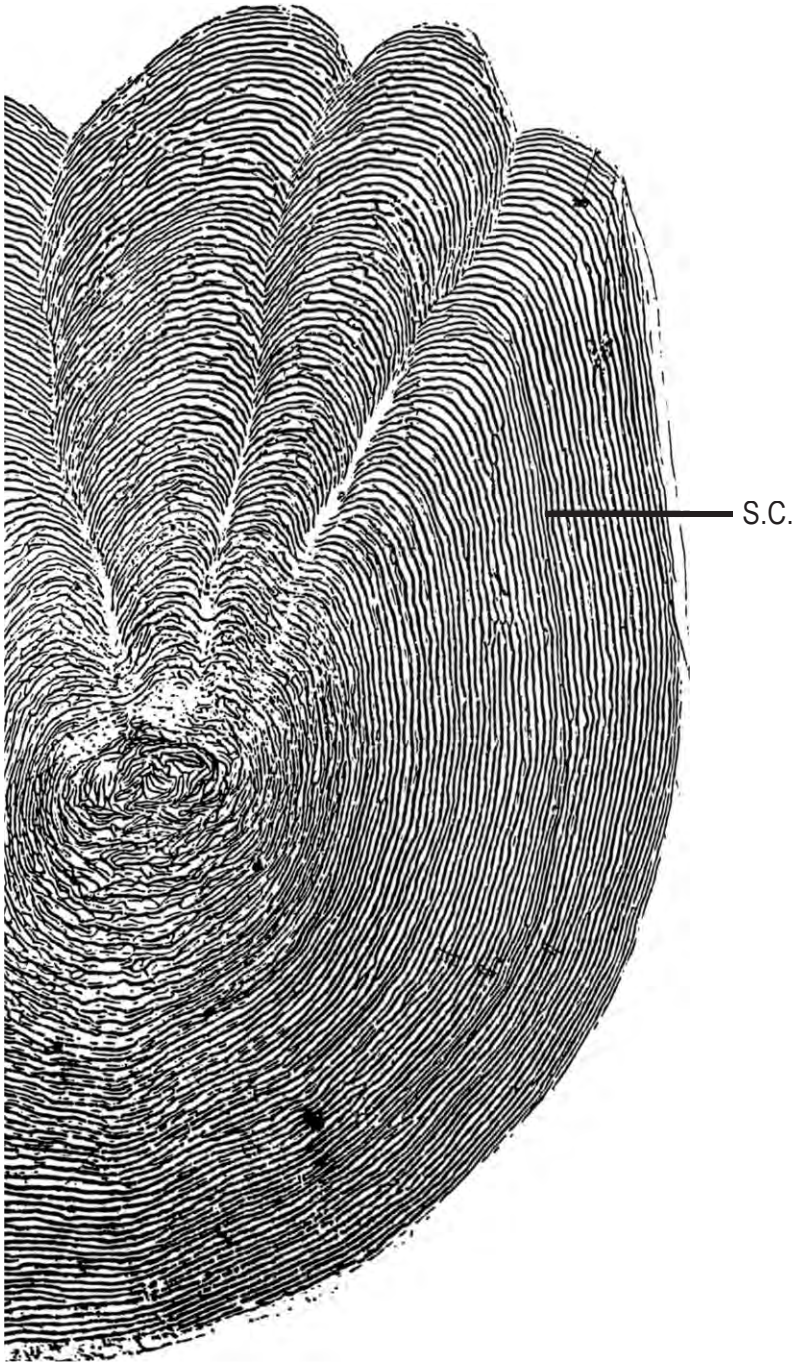


Figure 45.–Scale from an 11.0-inch young-of-the-year pike (tag F677) raised at Drayton Plains Hatchery and collected on September 30, 1952. Note the summer check (S.C.) which is seldom this pronounced in the first year's growth. 51.3X. (Figure 24 of Williams 1955).

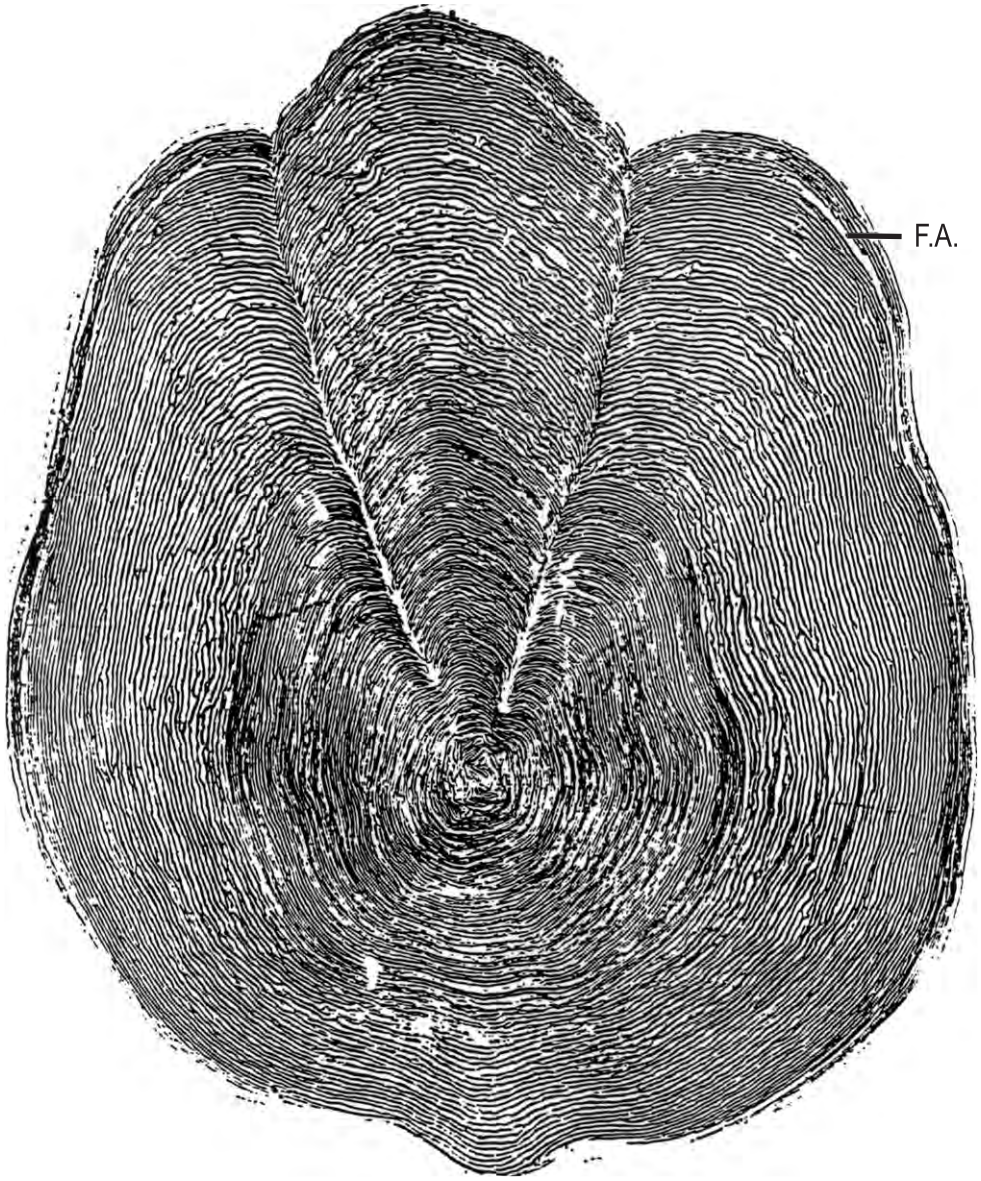


Figure 46.–Scale from a 14.8-inch, known age, yearling pike (tag 19855) collected at Drayton Plains Hatchery on November 9, 1938. Note the growth was slow for the first year but that growth compensation has occurred in the second year. The false annulus (F.A.) is considerably in at the anterior region but runs to the scale margin at the posterolateral region, a common occurrence in false annuli of pike (compare with Figure 47). 33.4X. (Figure 24 of Williams 1955).

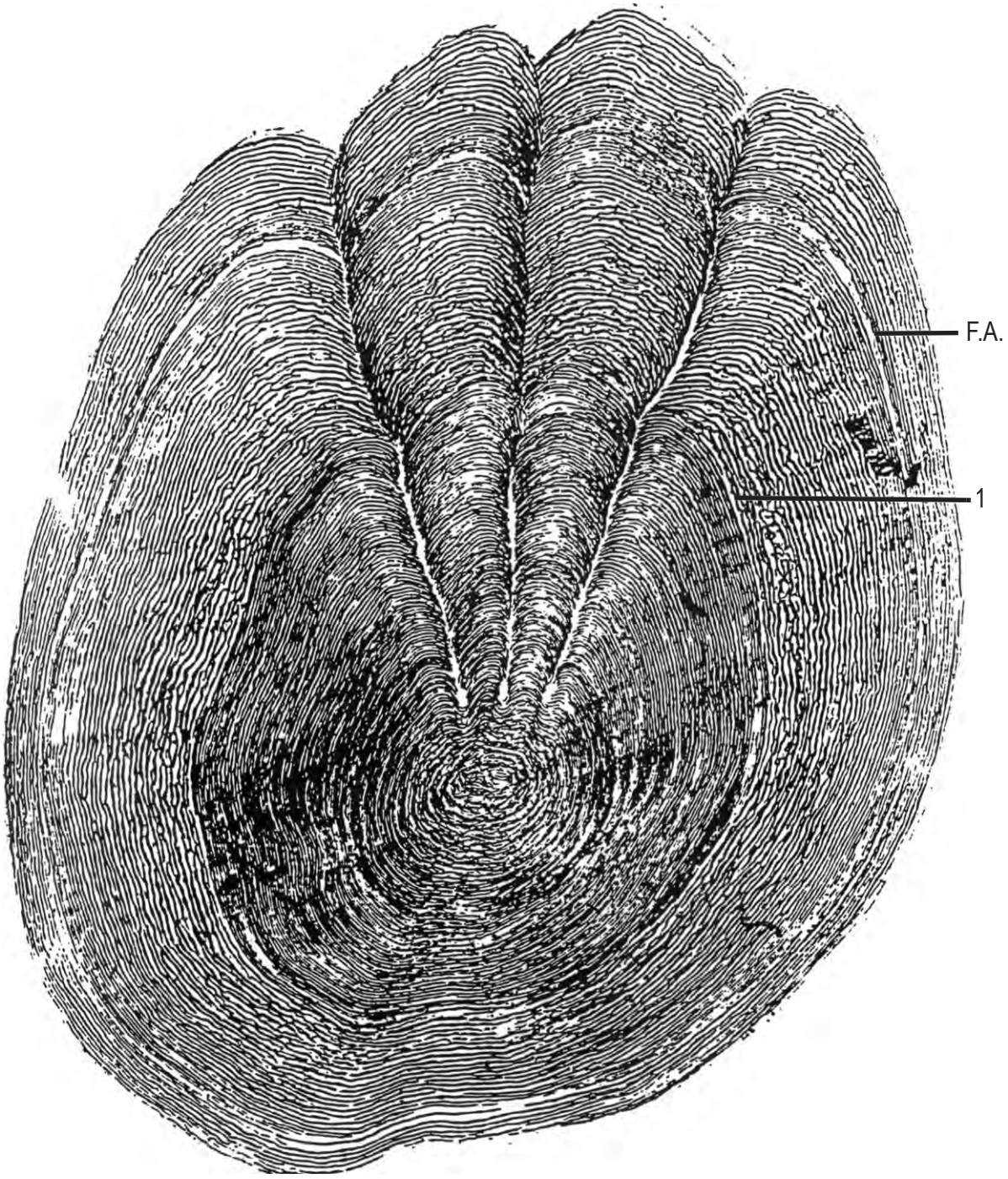


Figure 47.–Scale from a 14.0-inch, known age, yearling pike (tag 19837) collected at Drayton Plains Hatchery on November 9, 1938. The false annulus (F.A.) is considerably farther in from the margin of the scale when compared to Figure 46. Note that the false annulus may be identified by the few circuli (8) outside of it at the right posterolateral region and the many circuli (22) outside of it at the right anterolateral region. 38X. (Figure 26 of Williams 1955).

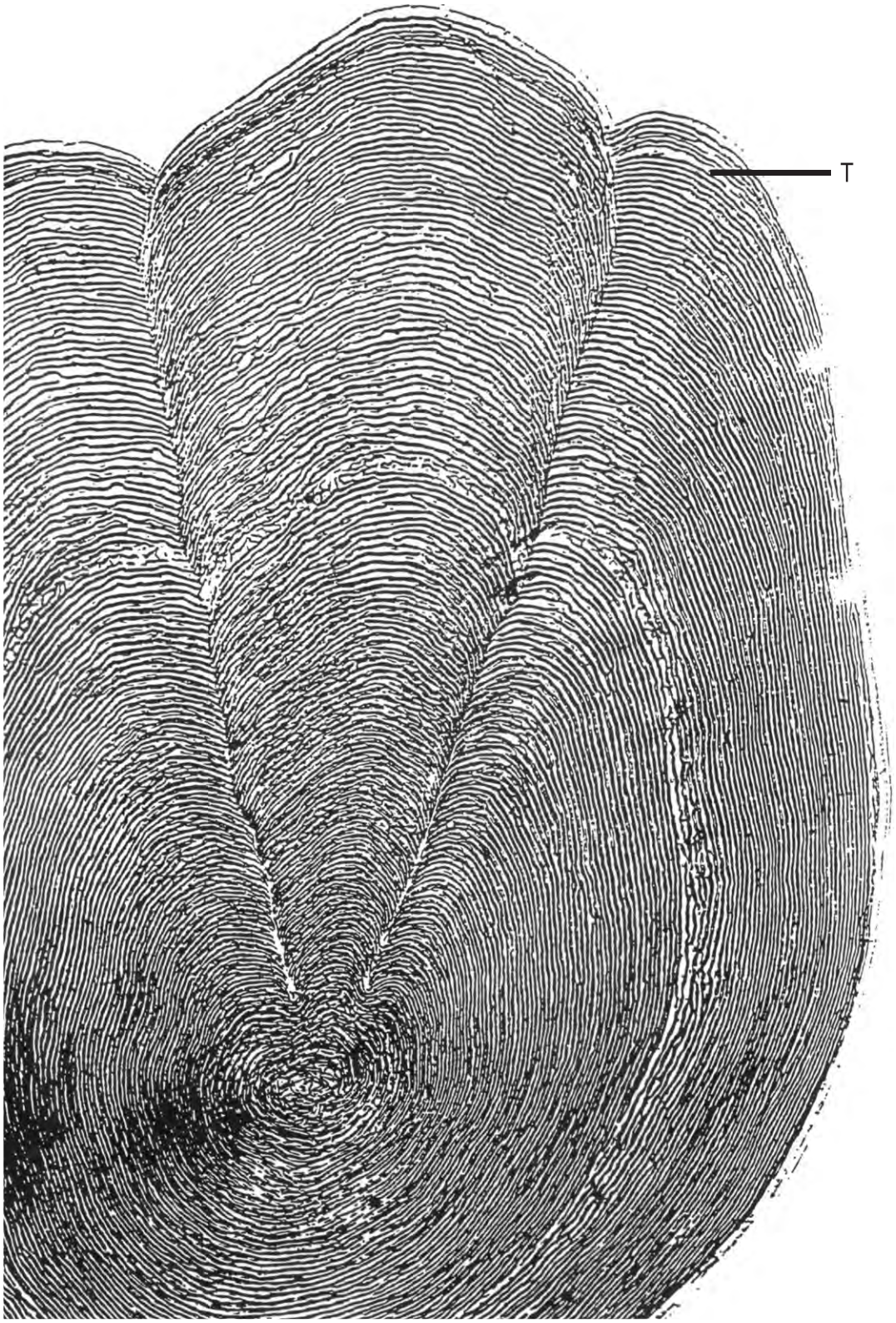


Figure 48.–Scale from a 14.0-inch pike, age 2*, from Orchard Lake, Presque Isle County collected on April 9, 1952, which had lost an opercle tag applied in August or October 1951. Note mark (T) caused by handling and tagging and that growth since that time was confined to the anterior and anterolateral portion of the scale. 41X. (Figure 30 of Williams 1955).

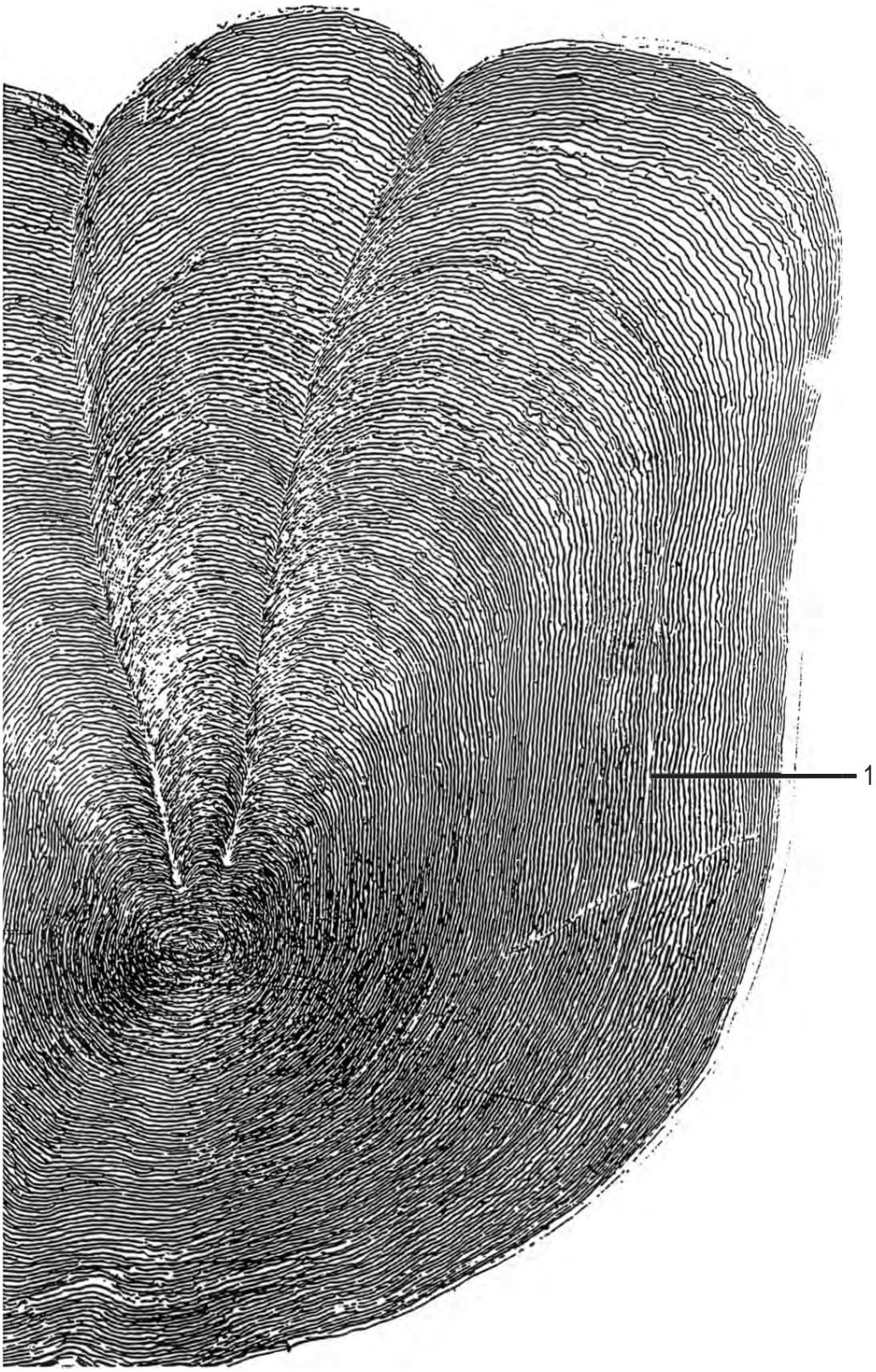


Figure 49.–Scale from a 21.8-inch, known age, yearling pike from Walsh Lake collected on July 17, 1945. Note the first annulus (1) is not chain-like and the extensive cutting over at the posterolateral region. Growth during 1948 had already begun to slow up after being rapid at the post-annulus period. 30X. (Figure 34 of Williams 1955).

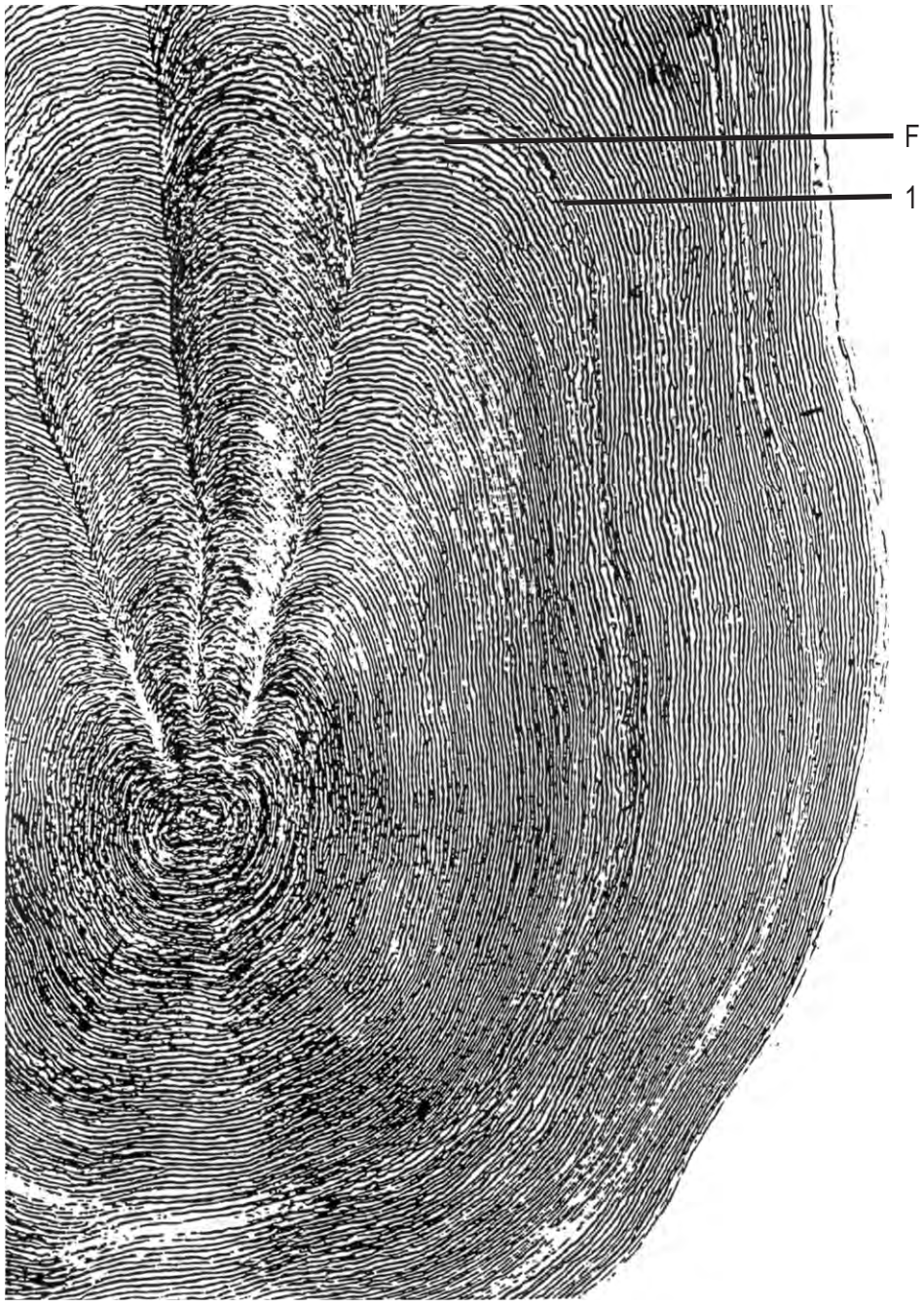


Figure 50.–Scale from a 23.5-inch pike collected at Whitmore Lake on April 18, 1953. Rapid fall growth (F) before first annulus (1) may be confused for growth after annulus if fish is taken before annulus formation. Note slow growth after first annulus. 33X. (Figure 13 of Williams 1955).

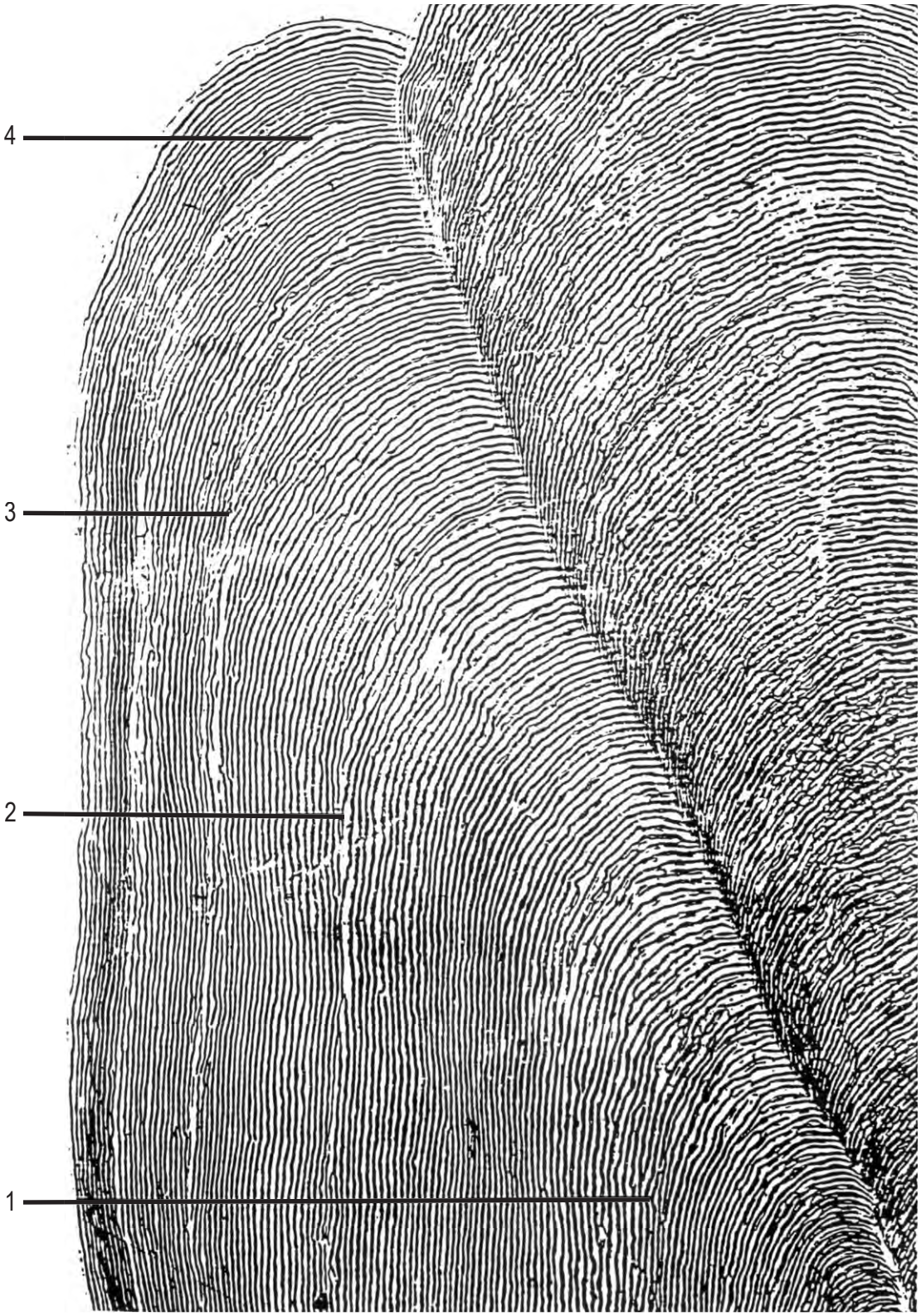


Figure 51.–Scale from a 22-inch, spent female pike collected at Waskesiu Lake, Saskatchewan on May 26, 1932 showing typical definite annuli, uncomplicated by false checks. Fifth annulus is forming at anterolateral margin. 46X. (Figure 12 of Williams 1955).

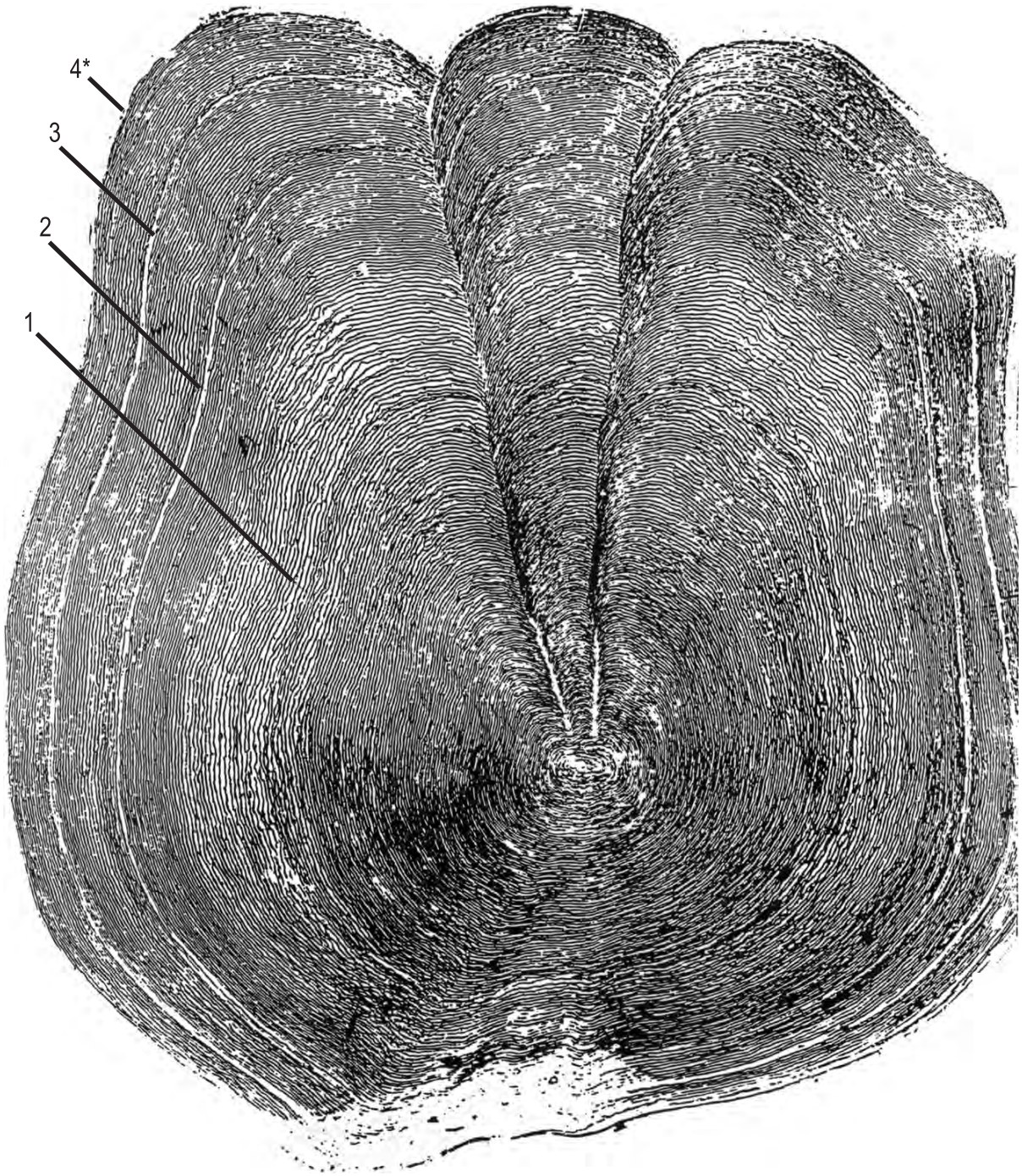


Figure 52.–Scale from a 31-inch, known age, four-year-old pike from Walsh Lake collected on January 28, 1945. Note the prominence of the three annuli (fourth would have been formed at the margin in spring, 1945) and the absence of false checks. Compare with Figure 49. 22X. (Figure 35 of Williams 1955).

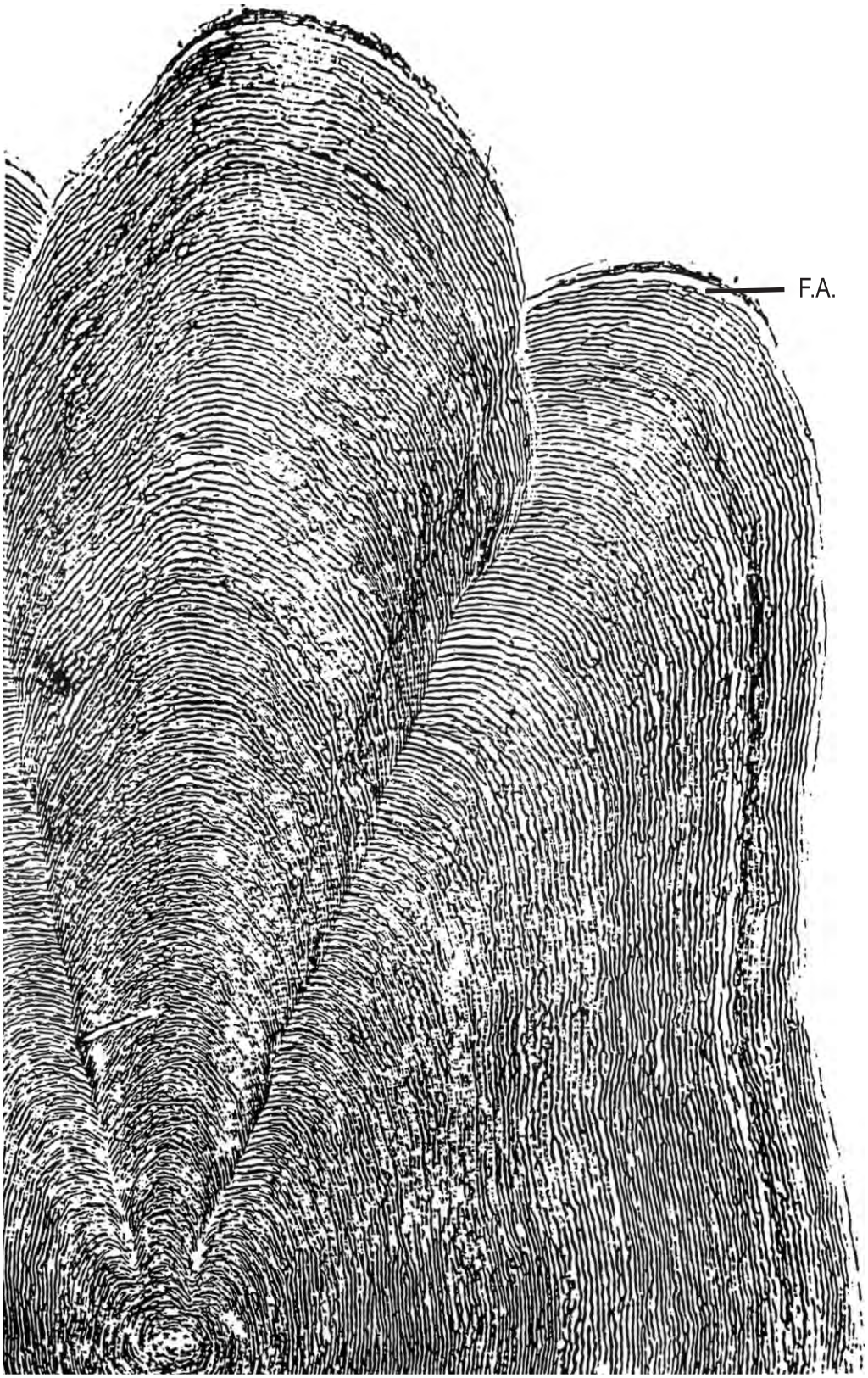


Figure 53.–Scale from a 21.2-inch pike collected August 29, 1948 from Fletcher Floodwater. Note the prominence of the false annulus (F.A.) recently formed at the anterior and the anterolateral lobes. 38X. (Figure 22 of Williams 1955).

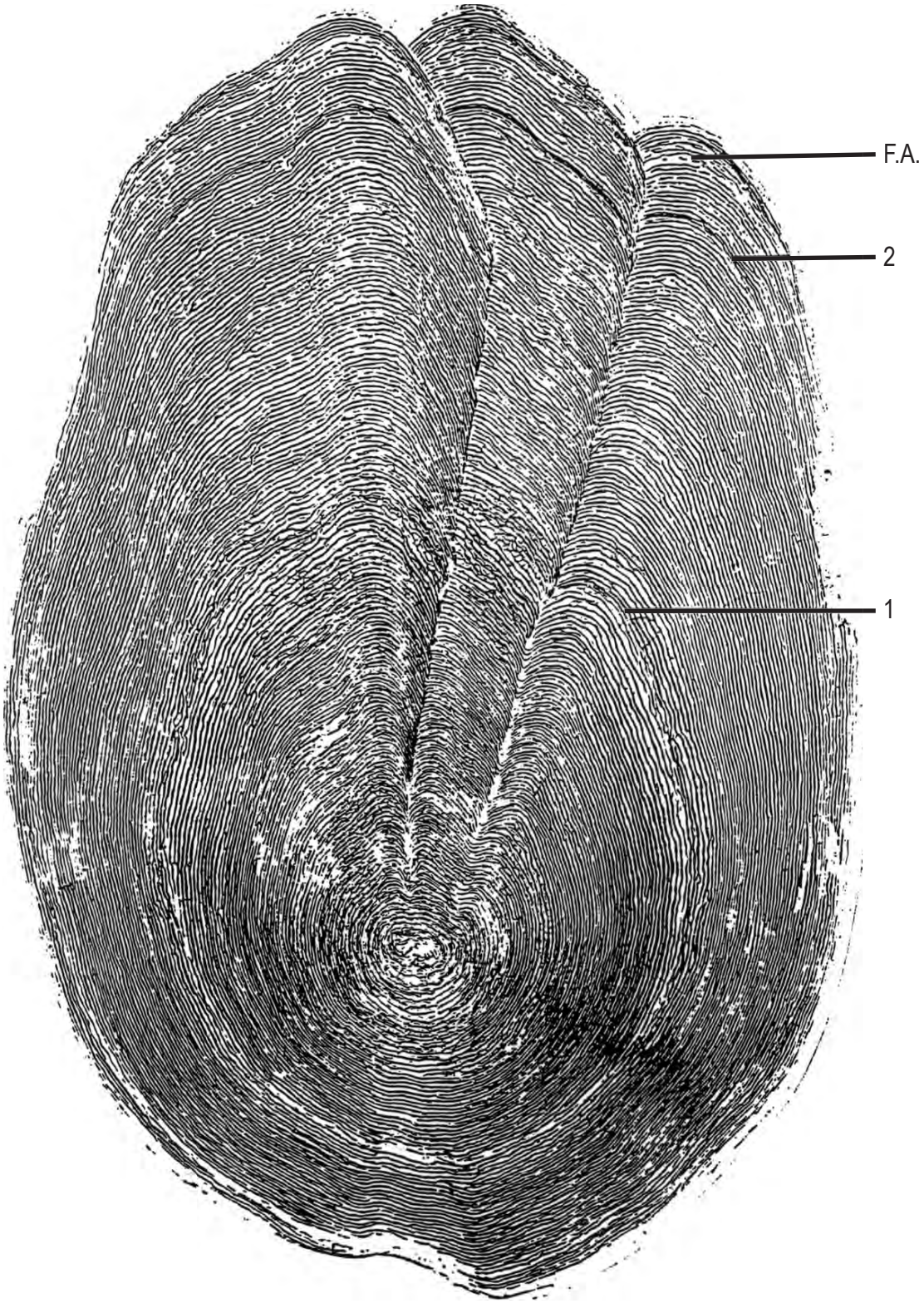


Figure 54.–Scale from a 20-inch pike (tag 32661) recaptured at Houghton Lake on May 15, 1942. First annulus (1) is between two areas of fast growth and the second annulus (2) consists of several close, irregular circuli at the anterior region and a white line at the posterior region. False annulus (F.A.) near the margin at the anterolateral region was formed the preceding summer, as the first scale sample (March 27, 1942) indicated it in the same position. 33X. (Figure 14 of Williams 1955).

Figure 55.–Scale from an untagged, known-age, three-year-old pike collected at Drayton Plains Hatchery on May 7, 1953. Note the prominent annuli (especially at the posterior region) and the formation of a false annulus (F.A.) at the anterior and anterolateral lobes, which would have combined with the true, 1953 annulus toward the posterior region. Also note the first summer growth-rate change near the focus. 33X. (Figure 31 of Williams 1955).

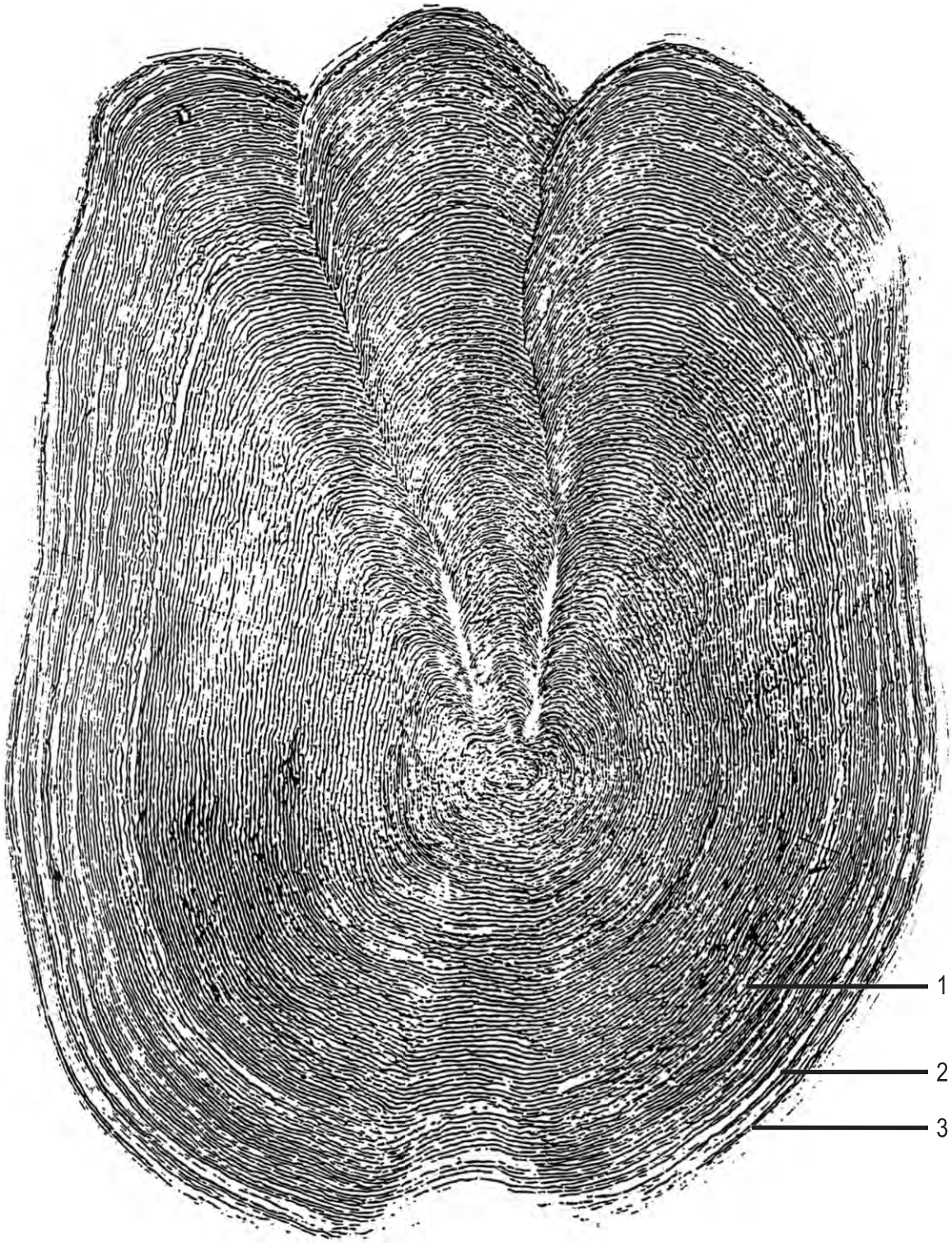


Figure 56.–Scale from a jaw-tagged (tag 67313), known-age, three-year-old pike collected at Drayton Plains Hatchery on September 30, 1953. Note the difficulty of placing the last two annuli, which are indicated clearest as white lines at the posterolateral regions. False annuli and slow growth rate due to jaw tagging complicated aging of this fish. 33X. (Figure 32 of Williams 1955).

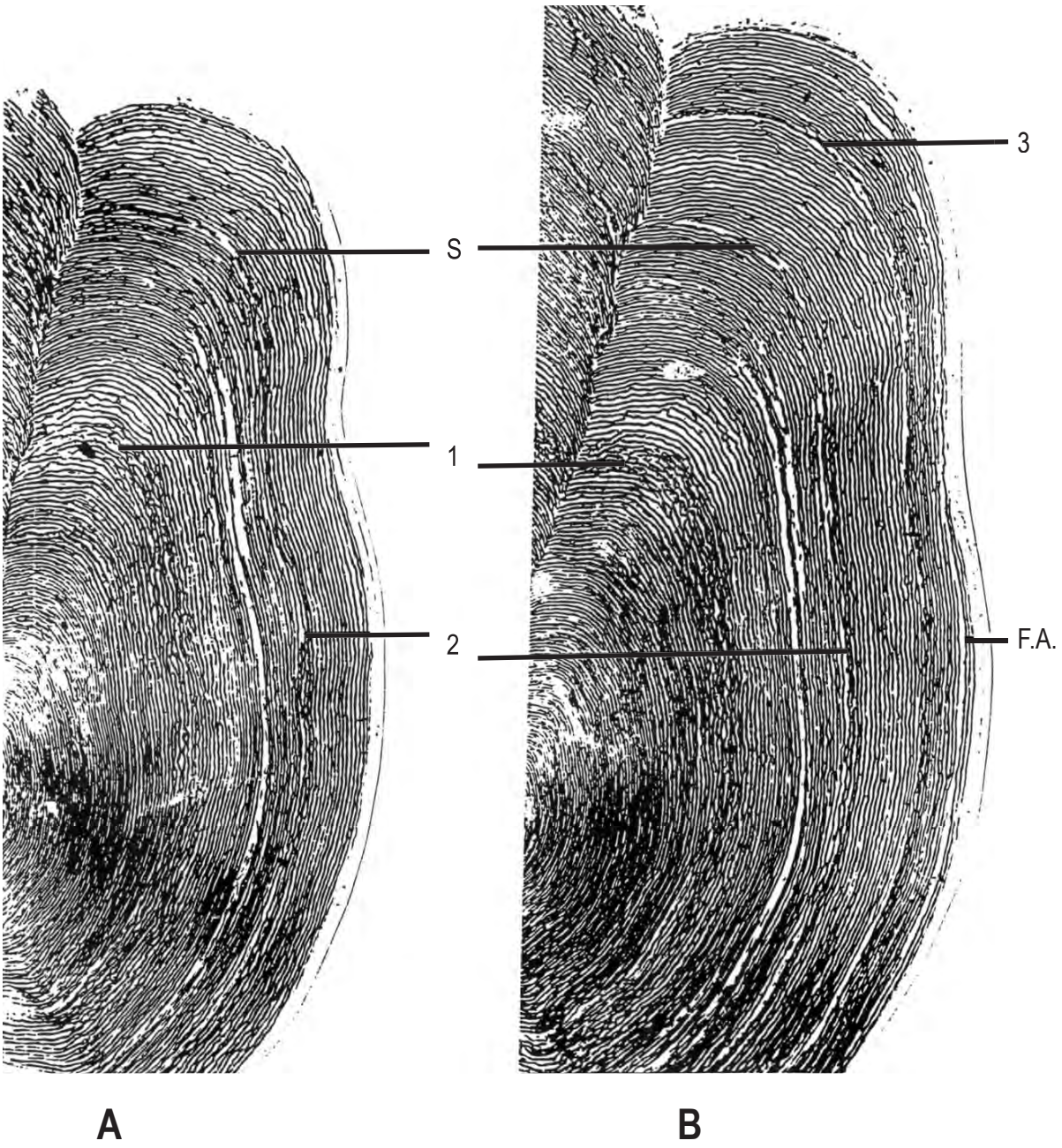


Figure 57.–Scales from a partly known-age pike (tag 22822) from Sugarloaf Lake which formed two annuli and a false annulus during the 22-month period the tag was carried. 29X. (Figure 27 of Williams 1955).

A. From a fish that was recaptured on March 17, 1953 at 19.8 inches in length, after being jaw tagged on March 20, 1952 at 16.9 inches in length. The spring, 1952 collection showed that the margin of the scale extended to point S, just before the first known annulus (2) was formed. A false annulus can be noted between 1 and 2. Note that no false annulus formed during the 1952 season.

B. From the same fish that was again recaptured on January 3, 1954 at 22.6 inches in length. The 1953 annulus (3) formed just after the March, 1953 collection (A above), but again, as in 1951, a false annulus (F.A.) was formed during the summer of 1953.

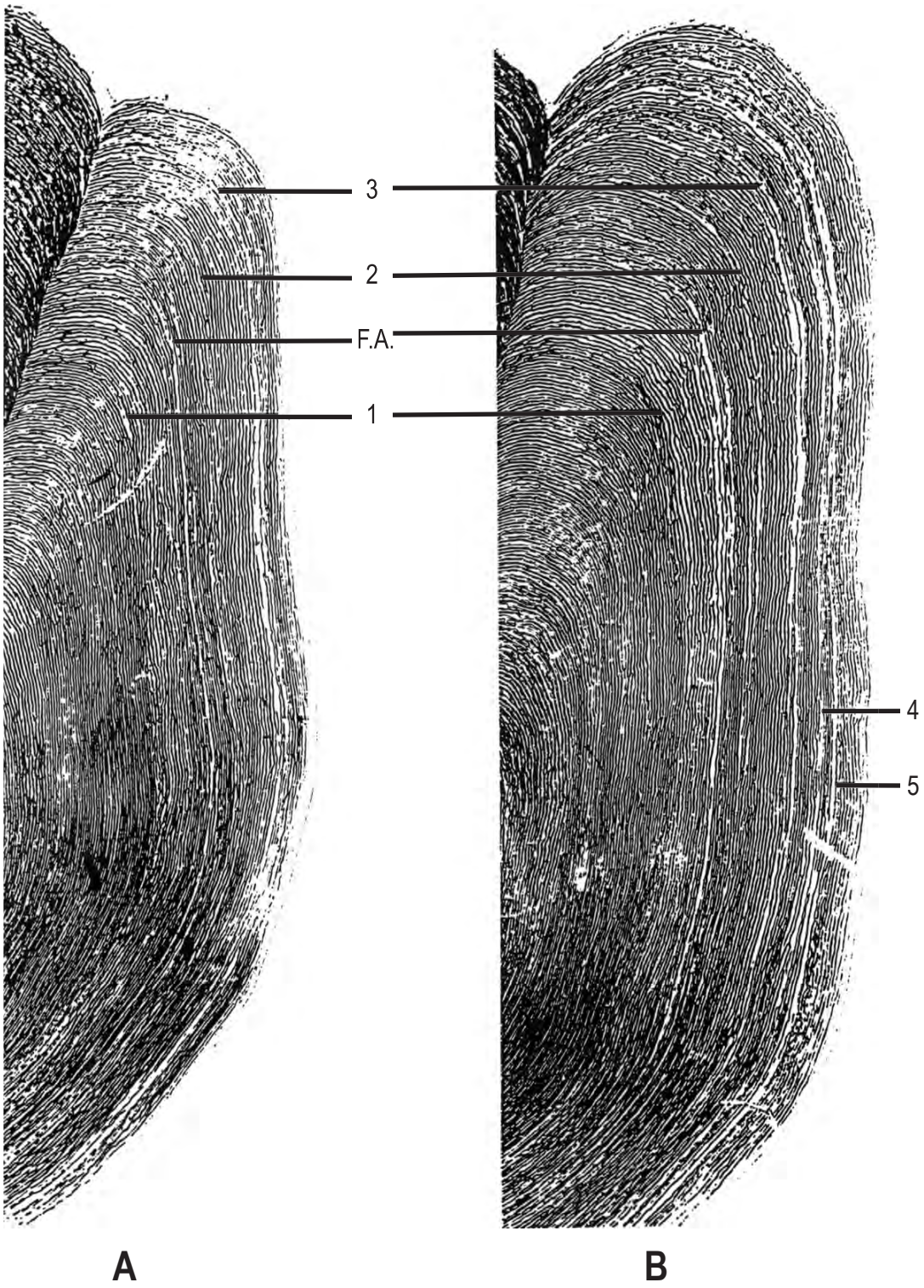


Figure 58.–Scales from a pike of partly known-age (tag 22808) from Sugarloaf Lake and recaptured 21 months later with two annuli formed during the tagged period. (Figure 15 of Williams 1955).

A. October 31, 1951, 26.0 inches, age 3. Note false annulus (F.A.) formed during second summer.

B. July 11, 1953, 29.0 inches, age 5. Note closeness of the two annuli and their parallelism from anterolateral to posterolateral. Growth to July of the 1953 season was considerably more than for the entire 1952 season.

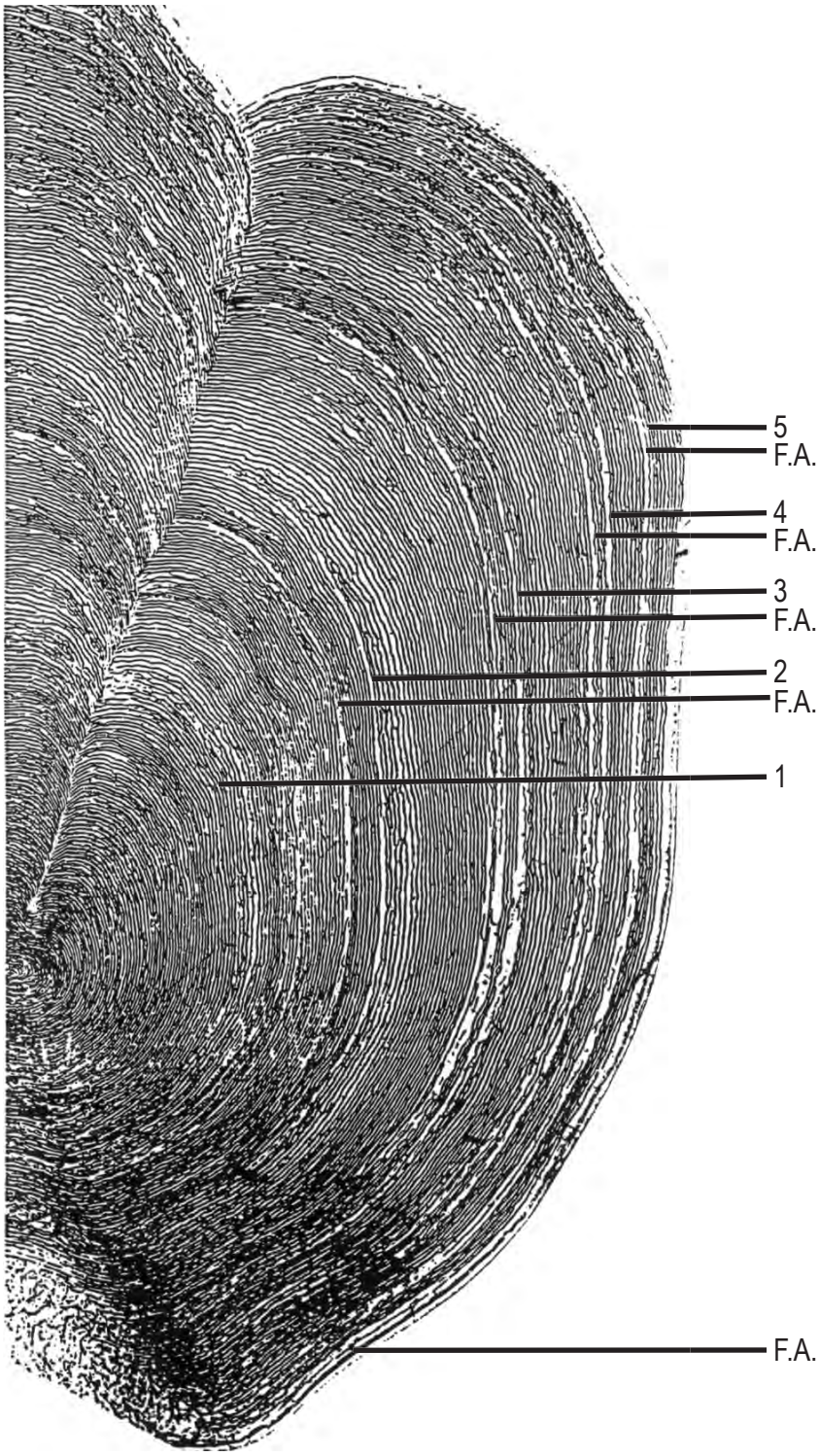


Figure 59.–Scale from a 30.9-inch pike of unknown age collected in Hess Lake, Newago County on August 20, 1953. Note the paired true (2, etc.) and false (F.A.) annuli forming "tracks" which are prominent and widely separated at the anterolateral but disappear at the posterolateral region as the false annulus fades. The tracking is pronounced at 2, 3, and 4, but at 5 the false and true annulus are separated by only one circulus down the lateral region. The false annulus, which would go with the 1954 true annulus, is already formed at the posterolateral region. 27X. (Figure 28 of Williams 1955).