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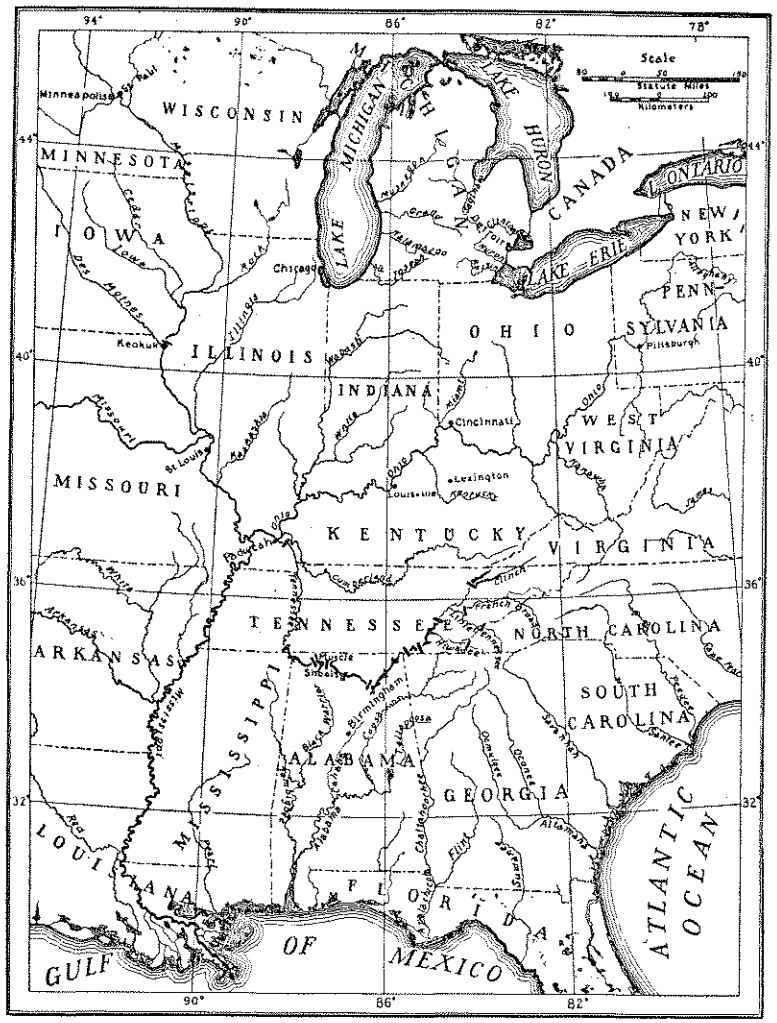

Map of the Eastern United States,
by Henry van der Schalie.

eigenschappen hebben, vooral bij oudere voorwerpen, is dit geen onderscheidend kenmerk voor *princeps*.

4. De vlakke boven- of rechterschelp is bij *princeps* zwak geribd. Daar bij *edulis* de bovenschelp als regel ongeribd is, moeten wij hierin het specifieke kenmerk van *princeps* zien.

Intusschen vindt men onder geschikte omstandigheden bij *edulis*, exemplaren met den bovengenoemden gekraagden rand, zoowel bij oudere als bij jongere exemplaren, m.a.w. die kraag is aan verplaatsing onderhevig. Waar eerst op b.v. 2-jarigen leeftijd een geribde buitenrand ter breedte van een cm aanwezig was, vindt men na een paar jaar dien rand weer terug aan de nieuw bijgegroeide gedeelten, terwijl op de oude plaats de ribben verdwenen zijn door het verloren gaan der lamellen. Slechts zeer zelden zijn de lamellen bestand tegen den tand des tijds. Alleen die exemplaren van *edulis*, waarbij die ribben op de rechterschelp zeer krachtig ontwikkeld en blijvend zijn, noemt Wood *Ostrea princeps*.

Wil men voor dezen overigens zeldzamen vorm een naam, dan behoort deze te luiden: *Ostrea edulis* L., var. *princeps* S. V. Wood.

Opmerking: Wij hebben de kwestie van het al of niet recent zijn buiten beschouwing gelaten, daar er geen wezenlijke verschillen aan te toonen zijn tusschen pliocene en recente exemplaren van *Ostrea edulis* L.

Contributing Factors in the Depletion of Naiades in Eastern United States

by

HENRY VAN DER SCHALIE

To the European malacologist, the disappearance of an indigenous fauna accompanying what is considered an advancing civilization is perhaps not unusual. Workers on the European continent are also well aware of the damage inflicted upon particular molluscan groups in many areas there. Yet, in view of the limited knowledge of conditions in Europe which

most American conchologists have, the writer will hazard the guess that few foreign workers realize what is happening to some of the important regions in the United States. With this situation in mind the following outline is given of conditions observed to influence our North American Naiad fauna within the past ten years. Most of the factors which prove detrimental to the *Naiades* will naturally be damaging to other groups, but because the writer's main interest has thus far centered about the Naiad fauna, only that group will be considered here.

As is generally known, the eastern half of the United States has the richest recorded fauna of freshwater mussels. For convenience this area may be divided into the following drainage systems:

I. Mississippi River
II. Tennessee River
III. Alabama River system
IV. Apalachicola drainage
V. South Atlantic Coastal drainages
VI. Rivers of the Great Lakes drainage in Michigan

Each of these areas will be discussed in relation to the major conditions now operating to reduce the abundance of the Naiad fauna.

I. Mississippi River: This river with its several tributaries was formerly the center of the pearl button industry in our country. The industry flourished during the first twenty years of this century, and for some time the mistaken notion existed that it was operating with an inexhaustible supply of mussel material. Tons of mussels were gathered during that period and the supply began to diminish noticeably. In an effort to devise methods to replenish the depleted supply, the U. S. Bureau of Fisheries carried on some extensive research at the Fairport (Iowa) laboratory which was in the former center of the industry. Some of the best research with *Naiades*, especially on methods of artificial propagation, resulted from the efforts by members of the Bureau staff to find a solution to the depletion problem. Not only were the mussels being

taken too rapidly by the fishermen, but pollution, silting and power dam development were beginning to take their toll. Eventually, the Bureau discontinued its efforts to salvage the industry by methods of artificial propagation.

Recently Dr. M. M. Ellis of the U. S. Bureau of Fisheries staff has carried on an extensive survey of conditions in the Mississippi. The river is practically devoid of mussels from the region of St. Louis, Missouri to its mouth, a condition accounted for by the tons of silt carried to the stream and deposited in it by the waters of the Missouri River which enters the Mississippi near St. Louis (see map). There is left roughly the upper half of the main river as the potential zone for mussel propagation. Dr. Ellis[1]) found that in this region also quantities of silt, which resulted from deforestation, improper methods of tilling the land and the present methods of road construction, were damaging to the fauna. Pollution, particularly below the several large cities located on the river and its important tributaries, was responsible for a heavy mortality in glochidia which were attacked by bacteria and infusoria. Finally, the construction of power dams, such as the one above Keokuk, Iowa (see map), has caused considerable damage to the Naiad fauna. The dam at Keokuk forms a ponded area known as Lake Cooper, impounding the water for about sixty-five miles. Factors as the deepening of the water, the increasing accumulation of silt and the slowing up of the current have created a habitat unfavorable to many of the mussels.

An investigation of the mussels of this region reveals that thirty-nine species, representing twenty-five genera, inhabit the upper Mississippi River. Of these forms, the largest number of species (thirty) is found just below a natural widening of the river known as Lake Pepin, while only fifteen species occur in the region of Lake Cooper. This drop in the number

[1]) Ellis, M. M. A Survey of Conditions Affecting Fisheries in the Upper Mississippi River.
U.S. Bureau of Fisheries, Fishery Circular No. 5, 1931, pp. 1—18.

of species is coincident with the changed conditions brought about by the impounding of the waters above the Keokuk dam. The writer is now preparing a more detailed report on the *Naiades* of the Mississippi.

II. Tennessee River: None of our larger rivers has undergone a greater transformation than the Tennessee. The immense program of the Tennissee Valley Authority promises to make this river a long series of huge artificial ponds (see map). The Wilson, Wheeler, Hales Bar and Norris dams are completed; the Pickwick Landing, Guntersville and Chattanooga dams are under construction; the Gilbertsville, Watts Bar and several others are being recommended for construction. In brief, this series of dams will eventually impound the waters of the Tennessee from its mouth at Paducah, Kentucky into its headwaters above Knoxville, Tennessee, a distance of approximately six hundred and fifty miles. The T. V. A. has a three-point objective in altering the river. It proposes: (1) to utilize the great power resources that the stream offers; (2) to control floods and soil erosion in the river valley; (3) to develop the navigation as well as the recreational possibilities of the region. However, we are at present not concerned with the progress affected by these tremendous changes, but only with effects on the Naiad fauna.

There is no river anywhere that equals the Tennessee in the production of freshwater mussels. About ninety species, comprising thirty-two genera, are found in this drainage. Many species and several genera are endemic to this river. Since the greater portion of the fauna is ecologically adapted to the shoal conditions formerly so abundant in the Tennessee, there is no question but that the impounding of its waters as a result of the T. V. A. program will practically destroy the *Naiades*. Mussels, for the most part, are extremely sensitive to such changes and from what is known of conditions following similar projects carried out on a smaller scale, relatively few species adapt themselves to the altered habitats. The ecological changes likewise threaten the existence of several of the aquatic gastropods. The endemic genus, *Io*, for example, may well be exterminated.

III. Alabama drainage: The state of Alabama is one of the richest states in the union in terms of molluscan species accredited to it. This extensive fauna is largely the result of the abundance of limestone in the region and the presence of three large rivers: the Tennessee, the Alabama and a portion of the Apalachicola system. Each of these drainages has a characteristic freshwater fauna, and the total number of species would make an imposing figure.

In a recent study of the mussels of the Cahaba River, the writer[1]) reports forty-five species of mussels, comprising twenty-three genera. This number represents the fauna of only one tributary of the Alabama. In northern Alabama the rivers have a steep gradient and produce a series of shoals ideal for many Naiades. Farther south, the main stream of the system crosses the Gulf Coastal plain and is characteristically large and slow-moving. The combination of habitats found in both areas gives an extremely diversified ecology.

The Alabama drainage has suffered from the industrial development of the Birmingham region and from silting brought about by intensive farming and road construction. A tributary, the Coosa River, which at one time had many fine shoals, has been turned into a series of huge ponds by dams used for the purpose of producing power for the steel industries of Birmingham. Several other tributaries, such as the Tombigbee, have been affected adversely by quantities of silt which now cover former mussel beds.

IV. Apalachicola drainage: The region drained by this river and its tributaries (Chattahoochee and Flint Rivers) has a strikingly peculiar fauna. For the most part, the *Naiades* differ decidedly from those of the Alabama drainage to the west and the Atlantic Coastal drainages to the east and south. There are approximately twenty species representing about nine genera. The genus *Quincuncina* is found nowhere else, and several species including *Elliptio sloatianus*, *Medionidus*

[1]) van der Schalie, Henry. The Naiades (Freshwater Mussels) of the Cahaba River in Northern Alabama. (In press).

kingi and *walkeri* and *Lampsilis jonesi* are restricted to this drainage. Zoogeographically the region is most interesting. Intensive farming in this area has caused considerable silting, and the clearing of the ground cover has resulted in devastating flood conditions.

V. South Atlantic Coastal drainages (Chesapeake Bay to Florida): Mussels are common in most of the rivers which cross the Atlantic Coastal plain. However, as compared to the fauna of the Mississippi and Gulf drainages, the number of genera and species here is greatly reduced, consisting of about ten genera, each containing but one or a few species. The only exception is the genus *Elliptio* in which there are numerous species. This region is evidently the center for the development of the genus. Since the region is relatively young geologically, there is a marked tendency for instability and intergradation of its many species. The writer has begun a series of studies of the *Naiades* of the coastal plain and hopes to be able to clear up much of the taxonomic confusion found there.

Several of the larger streams in the area, such as the Altamaha and the Savannah, are of a yellow color throughout most of the year due to the large amount of silt carried in suspension. The silt usually enters the rivers from the rolling regions in their headwaters where intensive farming and road construction have taken place. Mine wastes from coal mines in the headwaters of the James River have done much damage to the fauna of that stream.

VI. Rivers of the Great Lakes drainage in Michigan: Although Michigan is in the St. Lawrence drainage, its Naiad fauna has been greatly increased by the invasion of a number of species characteristic of the Mississippi drainage. This addition occurred during glacial times when certain Michigan lakes and streams were connected with the headwaters of the Mississippi River. At present the fauna consists of twenty-four genera including about forty-five species. The majority of species are found in the southern half of the lower peninsula, that is, below the Saginaw-Grand Valley region (see map).

Many factors are contributing toward the depletion of the mussels in this state. The Huron, Muskegon and other rivers have power dams. Industrial wastes and sewage are particularly damaging in the Saginaw drainage, the St. Joseph, the Kalamazoo, the Grand and the Rouge Rivers. Waste from beet sugar refineries is responsible for large unproductive areas in the Raisin and Pine Rivers. In many localities action has been taken by the state to curtail such destructive influences, though usually much irreparable damage has been done before preventive action has become effective.

Throughout the rich mussel-producing region of the Eastern United States various factors as silting, pollution by sewage, mine and industrial wastes, power-dam developments and unrestricted mussel gathering for the pearl button industry, have resulted in the critical depletion of the formerly abundant Naiad fauna. Although remedies have been introduced in some localities, there has been generally a decided detrimental change in the fauna. This change which is now occurring simply brings out the necessity for and the importance of intensive surveys in areas not yet harmed by these destructive agencies. Fortunately, many of the regions now destroyed have been visited by some of the earlier conchologists. However, much remains to be done particularly in regions which were formerly inaccessible.

Die am Nordseestrand der Insel Juist (Deutschland) angespülten fossilen Mollusken

von

C. O. VAN REGTEREN ALTENA, Amsterdam

Der holländische Strand gewährt dem Sammler im Allgemeinen eine ziemlich reiche Beute durch das Meer angespülter Molluskenschalen. Die Zusammenstellung des aus Molluskenschalen bestehenden Sediments ist jedoch nach dem Fundort qualitativ und quantitativ verschieden. Auf den ostfriesischen Inseln ist ein Molluskensediment zu erwarten, das neben einer