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A PUZZLE AMONG THE COMPOSITAE OF THE EASTERN HIGHLAND RIM[1]

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Within twenty-five miles of Cookeville, Tennessee, some 300 species of herbaceous vascular plants have been under casual observation by the senior author during the past thirteen years. Of these, only two species have attracted attention because of population changes. Some thirty-five species of Compositae are known to be fairly common locally, but only the golden aster, *Chrysopsis pilosa* Nutt., and the mistflower ("ageratum"), *Eupatorium coelestinum* L., by dint of increasing populations, have become especially conspicuous since 1956.

As the golden aster began to flower in August, 1959, it was observed more closely along Tennessee Highway 42 leading north along the eastern part of the Highland Rim to the Tennessee-Kentucky line. This preliminary survey showed that this aster was very abundant in Putnam County, present but in decreasing numbers north of Livingston in Overton County, and apparently nonexistent in Pickett County as far as the border town of Static. Because of this unexpected distribution, the decrease to the north along the Highland Rim, a more intensive and extensive study was planned. Was the scarcity farther north limited to this species or was it true of other Compositae flowering contemporaneously?

In seeking the answer, two other species were used at first. Then one, Joe-Pye-weed, *Eupatorium* sp., was found to be so scarce that another species, the mistflower, *Eupatorium coelestinum* L., which was flowering profusely in Putnam County during September, 1959, was used for comparison. Appropriate portions of three farms, on or near Tennessee Highway 42, were studied intensively. The results of this survey are shown in Table I. Similar terrain in Putnam County was explored carefully. These results are given in Table II. Old fields, pasture land, and forest margins were the most satisfactory sites. The only obvious difference was the use of three or four vacant lots in the northern environs of Cookeville. No vacant lots were studied in Pickett

1. Data for Pickett County, in part, are those secured by Mrs. Carrie Mitchell for a special problem in local flora, Biology 451 G. The writers are indebted to Dr. Howard Ashburn for the loan of topographic maps and to Professor Willis Huddleston for information on soils of Putnam County, both members of the Faculty of Tennessee Polytechnic Institute.

County.

For the golden aster the tabulated data agree with those secured in the preliminary surved along Tennessee Highway 42. From these records it is apparent that comparable portions of Pickett and Putnam Counties are favorable for certain late-flowering species of Compositae. Three species, as shown in Tables I and II, are common to both counties, but in Putnam the same three species are closely associated with the golden aster, *Chrysopsis*. All parts included in the two tables are on the eastern part of the Highland Rim. Therefore it is a reasonable asumption that the environment in both counties is not unfavorable for the golden aster. Additional facts justify this assumption:

1. Those parcels of land under intensive observation are similar in altitude, i.e. between 875 and 1150 feet above sea level.

TABLE I

Distribution of four species of Compositae in parts of Pickett County, Tenn.

	Farm A[1]	Farm B	Farm C	Along Tenn. Hwy. 42
Chrysopsis pilosa Nutt.	0	0	0	1
Eupatorium coelestinum L.	440[3]	60	600	Present, not counted.
Joe-Pye-weed[2] (*E. purpureum* L.?)	3	0	6	Present, not counted.
Ironweed (*Vernonia altissima* Nutt.?)	64	44	30	Present, not counted.

TABLE II

Distribution of the same species in Putnam County, Tennessee[4]

C. pilosa Nutt.	6000
E. coelestinum L.	300
Joe-Pye-weed	50
Ironweed	30

1. Farm A. was that of L. B. Mitchell, one mile north of Byrdstown along Tenn. Highway 42.
   Farm B. was that of Edgar Glass, five miles southwest of Byrdstown, a half mile west of Tennessee 42, and extending to a prong of Dale Hollow Lake. (None of these species was found along the Lake in lower ground.)
   Farm C. was that of James Dillon, two miles northeast of Byrdstown, and near the Mitchell farm, but facing Backbone Road.
2. The ironweed and Joe-Pye-weed were not compared with other specimens in an established herbarium, but the other species compared favorably with specimens in the herbarium of the Botany Department at the University of Tennessee.
3. Wherever the number is given as 100 or more, close approximations were used. In all other cases, the actual count is given.
4. The are a covered consisted of about 200 acres. These sites were situated along both sides of, and within a half mile of, Tennessee Highway 135, a continuation of North Dixie Avenue in Cookeville. In the same area at least 300 specimens of *Eupatorium*, probably *E. serotinum* Michx., and fully as many goldenrods (*Solidago sp.*) were noted.

2. The soils in both areas have a similar origin. Both are derived mostly from mixed hardwood forests and their precursors, plus the distintegration products of Mississippian rocks, largely limestones with occasional thin beds of shale or other materials.
3. Both counties are bordered by the Cumberland Plateau to the east, the parts studied being about equidistant from that Plateau.
4. The drainage from both areas is to the west and northwest, ultimately into the Cumberland River. (Drainage of the southern part of Putnam County is different, southward and westward into the Caney Fork River.)
5. Wherever comparisons have been made the soils have a similar appearance on eroding surfaces. The darker top soil is typically thin. The clay subsoil ranges from near yellow to red. This is intermixed with chunks of chert of various sizes.

Jillson (1948) states that the soils of the "Byrdstown Plain" – on which the three farms (cf. Table I) are located and over which several miles of Tennessee Highway 42 extend – are derived from the St. Louis and Warsaw formations, both Mississippian in age and mostly limestones.

Assuming that the seeds (fruits, achenes) of the golden aster are carried by prevailing winds, from the southwest, why did they reach and develop in Putnam but not in Pickett County? The distribution of *Chrysopsis pilosa* Nutt. is given as "Sandy or rocky woods and openings, s.Mo. and Kans. to La. and Tex." (Fernald, 1950, p. 1380). Gleason (1952) is in essential agreement on this point. The nearest reported for this species, as of 1949–1951, (both Fernald and Gleason, *ibid.*), was at least 400 miles due west of the Highland Rim north of Cookeville. The nearest approach to the southwest was even greater. DeSelm (1959), in identifying the boundary of the Central Basin of Tennessee, called attention to a potential block on the Highland Rim produced by outliers of the Cumberland Plateau in Overton County. This elevated region is certainly athwart the Rim. The possibility of a barrier in the probable path of an invading plant species is interesting, but the evidence now available does not support this hypothesis.

Two facts – gaps in the outliers and the occurrence of the golden aster atop the Cumberlands – conflict with the barrier hypothesis. These outliers of the Cumberlands do not form a solid wall across the Highland Rim. Tennessee Highway 42 passes through huge gaps in them. The engineers were not forced to lay out the road over higher terrain. While these outliers loom clearly along the road, none has the full stature of the Cumberland Plateau to the east in Overton County. Appropriate topographic maps show one "knob" at 1675 feet,

but most of these elevations are not over 1400 feet, the most notable at the east end of Standing Stone State Park. The presence of the golden aster of the same species on the Cumberland Plateau, east of the Rim in Putnam and adjacent counties, is attested by specimens in the herbarium of the Botany Department of the University of Tennessee. Neither of these two facts favors the barrier hypothesis.

No attempt has been made to correlate the distribution of any of these species of Compositate with pH or other factors. If later observations seem to warrant them, quantitative studies may be attempted. It is evident already, however, that the two species of *Eupatorium* are more numerous, as well as more luxuriant, in moist areas, while this is not true of the other two genera included in Tables I and II. Aside from a few extreme situations, wherever several species of Compositate grow profusely there *Chrysopsis* grows extensively in Putnam County but not in Pickett County.

The mistflower, *Eupatorium coelestinum* L., is a wide-ranging species (Fernald, 1950, p.1370). Its presence along the Highland Rim in the three counties under consideration is to be expected. More mysterious is its increasing abundance, along with that of the golden aster, during the last two years. No marked changes have occurred in the environment during this period. The rainfall has been slightly heavier than in some previous years, i.e. near its maximum of 55 inches per year (reported by C. K. Flatt, local weather recorder.). Perhaps the high reproductive potential characteristic of many species of Compositate is just now beginning to assert itself. Observations during the next two seasons are expected to clear up this point.

The golden aster, *Chrysopsis pilosa* Nutt., clearly shows indications of a high reproduction potential, and is a strong competitor in many of the local habitats. A typical plant produces no less than fifteen heads and each of the larger heads consists of at least 40 florets. The count is as high as 60 florets in a few heads picked at random. Both disc and ray florets are usually fertile. Hence, during a favorable season, one vigorous plant produces between 500 and 900 viable achenes. Compared with the common dandelion and some of the milkweeds, the aster achenes are not as well adapted for distribution by wind, but within three months after flowering essentially all achenes have been removed from the receptacle.

Locally, the golden aster does not invade swamps or woodlands, but in most habitats it competes on better-than-even terms with other members of its family such as the common ragweed, *Ambrosia artemisifolia* L., and the goldenrods, *Solidago* spp. Whenever and wherever cleared upland has been left untilled and unmowed for as much as three seasons, there the bright yellow heads of *Chrysopsis* are almost certain to be abundant

on the Highland Rim of Putnam County. The only observed stronger competitors have been among the grasses. Where certain of these have developed heavy stands over the years. the golden aster meets, none too well, the severe competition. This fact is apparent in local patches of Johnson grass, *Sorgum halepense* (L.) Pers., Bermuda grass, *Cynodon dactylon* (L.) Pers., and broom sedge, *Andropogon virginicus* L., locally called "sage grass".

The possibility that this species of *Chrysopsis* has reached the ultimate limits of its range must not be overlooked Its failure to reach the northern portion of the Highland Rim in Pickett County does point to a range limited by temperature and/or other climatic factors. For those who have inspected the likely spots in three counties – Putnam, Overton, and Pickett – south to north, in the order given, this possibiltiy is not impressive. There is too little difference in weather and climate for these three counties at the altitude of the Highland Rim. Unless there are marked climatic changes within a few years, it seems far more probable that the golden aster will become a denizen of this geographic area clear to the Kentucky line.

This concluding section may deserve the title of epilogue rather than summary. Seldom does one realize fully where a casual observation may lead. About August 15, 1946, the writer noticed for the first time the bright yellow heads of a wild aster in vacant lots and along roadsides leading away from Fitzgerald, Georgia. This was a very casual observation by one who was primarily concerned with the feeding signs of the white-fringed beetle – a serious crop pest under investigation by the U. S. Department of Agriculture (Bureau of Entomology and Plant Quarantine). Between that summer and September, 1953, no golden asters were noticed anywhere much less in Putnam County. Even then only a few scattered plants were seen by the writer and by Professor Willis Huddleston who was studying the weedy pests of crop lands of Putnam County (Personal communication).

In the same year the mistflower, a single plant, was found in open woods along Pigeon Roost Creek – one-time favorite collecting spot for Professors Bartoo and Shaver in the 1930's. Both, mistflower and golden aster in season, have appeared in ever-increasing number since then. During the current season, 1959, they have been the conspicuous species of their family along the eastern Highland Rim in Putnam County. While the mistflower is less numerous than the golden asters (cf. Table II), it attracts attention because of its color, lilac-purple and many have been transplanted into local flower gardens.

It is hoped that casual, or more than casual, observations by others in the eastern half of Tennessee may lead to a complete elucidation of the puzzling distribution of the golden aster on

the eastern Highland Rim, and finally, to the discovery of the factors responsible for the recent greatly increased populations of both species of Compositae.

REFERENCES CITED

De Selm, H. R. 1959. A new Map of the Central Basin of Tennessee. *Journal Tennessee Academy of Science*. 34 (1) 66-72. Jan., 1959.

Fernald, M. L. 1950. *Gray's Manual of Botany*. 8th Ed. Pp. 1--lxiv 1-1632. American Book Company, New York City.

Gleason, Henry A. 1952. *The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada*. Vol. 3: 1-111, 1-589. New York Botanical Garden, New York City.

Jillson, William R. 1948. *The Geology of Pickett County, Tennessee*. Roberts Printing Company, Frankfort, Ky.

SEMI-EMPIRICAL INVESTIGATIONS ON THE NATURE OF THE f-VALUE[1]

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ABSTRACT

It is suggested that an analysis of available f-value for atoms and ions would yield semi-empirical understanding of the emission process and would be temporarily useful in technological applications. Current literature search for this purpose is reviewed. A sample analysis, carried out with calculated transition probabilities of Pasternack (1940) is described. Promising experimental studies are suggested.

INTRODUCTION

In the early days when oscillator strengths of all the lines of any element, measured with canal ray experiments, were thought to be the same, Kerschbaum (1927) suggested comparisons of the various resulting values in a search for understanding of atomic radiation. Vastly improved measurements and well-advanced calculations of f-values for neutral and ionized atoms totaling hundreds of lines suggest that a renewed effort be made to study the emission process by comparing the available figures.

A second motivating cause for such a comparison is the fact that, though many f-values are indeed available, there are not nearly enough to meet the diverse needs of a rapidly expanding technology. Measurements of high temperatures in all sorts of new devices require new f-values, though not of very great pre-

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