INTRODUCTION
There is a paucity of literature on taxonomic and ecological studies of aquatic algae in Tennessee, since most of the aquatic ecological studies that have been done in this state relate to fish rather than to algae. The only previously published reports of studies on aquatic algae in Shelby County concern the Mississippi River and its tributaries (Hofstetter and Mangold, 1970; and Staab, et al., 1970).

METHODS
In the present study, algae from two Shelby County pond samples were collected (on the basis of an assumed difference in fertility) were compared with respect to taxonomy and ecology. Samples were taken from several stations in a modified Hale water sampler (Welch, 1948; and Dorris and Butler, 1961) at two-week intervals from July 31, 1965, to December 31, 1965. Parameters measured were depth, water temperature, turbidity, dissolved oxygen, carbon dioxide, pH, alkalinity, orthophosphate, total nitrogen, total carbon, and total phosphorus. Identification of algae followed Smith (1950), Proctor (1954), and Palmer (1962).

RESULTS
The hypothesis that Ball Pond is more fertile than Stewart Pond appears to be supported by the data from the dissolved oxygen, organic carbon and total phosphorus tests. On the other hand, the pH data would seem to suggest that Stewart Pond, having a higher average pH, may be as fertile or more so than Ball Pond as far as mineral availability is concerned, since both are classified as carbonate water. Biological disturbances resulting from positive changes in the Cyanophyta and blue-green algae are likely to occur in both ponds. This is indicated by the fluctuations in the frequency of occurrence of these algae in the ponds.

LITERATURE CITED
Welch, T. 1948. Biological disturbances resulting from an increase in the Cyanophyta and blue-green algae. Cited in Dorris and Butler (1961).

THE STUDY GROUP
The rapid expansion of earth and space science in Tennessee schools was, approximately, co-incident with the beginning of a major college-level curriculum in earth and space science supported by The National Science Foundation and called the Earth Science Teacher Preparation Project (ESTPP). ESTPP began with a staff of educational theorists and an advisory council of eleven faculty members from colleges and universities with experimental programs in earth science teacher preparation. One of the eleven ESTPP advisers, James X. Corgan, represented a Tennessee university with an experimental program (Corgan, 1972, 1973).

In the Fall of 1971, ESTPP funded a three-day regional conference held in the Land-Between-the-Lakes and attended by about fifty-five educators from Tennessee, Kentucky and Illinois. The Tennessee contingent, about twenty-six people, represented classroom teachers, science education specialists, educational service agencies, college departments of education, college departments of earth science, and college science faculties. The main concern of the Tennessee group was the need for a viable certification for earth and space science teachers. To assist in the development of a certification program, they formed an Earth and Space Science Study Group.

During late 1971 and early 1972, the Study Group reviewed the course of the study, Cyanophyta were found more frequently and more abundantly in Ball Pond than in Stewart Pond. This would suggest a greater fertility for Ball Pond, since the algae there are frequently found in waters with high organic content (Wilson and Loonis, 1971) and are known to require large amounts of nitrogen for their highly proteinaceous protoplasm (Proctor, 1960).

Earth Science Teacher Preparation

Volume 45, Number 1, January 1974

Earth Science Teacher Preparation: A State-wide Perspective

R. Jerry Rice and James X. Corgan

Tennessee State Department of Education
Nashville, Tennessee 37219

and

Austin Peay State University
Clarksville, Tennessee 37040

Abstract
Earth and space science is a rapidly expanding teaching field in Tennessee secondary schools. Two new teacher certification programs are going into effect in February, 1974, Certifications are only meaningful if colleges offer courses that meet requirements. This paper describes the development of Tennessee's new certification programs and reports on the course offerings in fifty-three post-secondary institutions. Almost half of all four-year schools can graduate students who meet broad-field certification requirements and thirteen percent have courses that meet requirements for single-subject endorsement. Data used in this article reflect course offerings prior to announcement of certifications. Changes in future years should show the impact of new secondary school certification on college curricula.

Introduction
During February 1973, the Tennessee State Board of Education approved both single-subject and broad-field requirements for teachers in the earth and space science. Endorsements become effective in February 1974. This action was the first formal recognition, by the Board, of the important role earth and space science now plays in the curricula of Tennessee secondary schools. For Tennessee teachers, it was also the first clear and official statement of the minimum professional background required for competence in the classroom.

State Board guidance is especially important because this field is new and rapidly growing. In the 1968-69 school year, only one public school system in Tennessee offered earth and space science, but by 1970-71, 141 of 147 public school systems had indicated plans to adopt an earth and space science text (Rice and Corgan, 1971; Corgan and Rice, 1973). This explosive growth created problems in teacher preparation. Tennessee's State Board of Education offers guidance to teachers and to institutions that prepare teachers. Before either colleges or teachers can be certified, the Board must be convinced that the students meet the guidelines. The Board guidelines are reasonable, desirable and attainable. This article traces the development of new endorsements and describes a survey of related coursework in post-secondary institutions. It then attempts to appraise the current status of earth and space science teacher preparation in Tennessee.

The Survey

The rapid expansion of earth and space science in Tennessee schools was, approximately, co-incident with the beginning of a major college-level curriculum in earth and space science supported by The National Science Foundation and called the Earth Science Teacher Preparation Project (ESTPP). ESTPP began with a staff of educational theorists and an advisory council of eleven faculty members from colleges and universities with experimental programs in earth science teacher preparation. One of the eleven ESTPP advisers, James X. Corgan, represented a Tennessee university with an experimental program (Corgan, 1972, 1973). In the Fall of 1971, ESTPP funded a three-day regional conference held in the Land-Between-the-Lakes and attended by about fifty-five educators from Tennessee, Kentucky and Illinois. The Tennessee contingent, about twenty-six people, represented classroom teachers, science education specialists, educational service agencies, college departments of education, college departments of earth science, and college science faculties. The main concern of the Tennessee group was the need for a viable certification for earth and space science teachers. To assist in the development of a certification program, they formed an Earth and Space Science Study Group.

During late 1971 and early 1972, the Study Group reviewed the course of the study, Cyanophyta were found more frequently and more abundantly in Ball Pond than in Stewart Pond. This would suggest a greater fertility for Ball Pond, since the algae there are frequently found in waters with high organic content (Wilson and Loonis, 1971) and are known to require large amounts of nitrogen for their highly proteinaceous protoplasm (Proctor, 1960).

The Survey
This survey solicited information from all post-secondary institutions in Tennessee that offer academic programs and are accredited by the Southern Association of Colleges and Schools (HEW, 1972). Survey instruments were mailed to 89 academic and thirty-four four-year schools. Three kinds of data were solicited:

1. Information on the number and variety of earth and space science courses offered during the 1972-73 academic year.
2. Information on the existence of format major and minor programs in earth and space science.
3. Data on the administrative locus of earth and space science offerings.

All but one of the two-year institutions returned a survey. However, there was an 89 per cent response from four-year institutions. Data for schools that did not respond were obtained from current catalogs. It is thus possible to characterize the current status of
earth and space science teacher preparation in Tennessee is in high demand. These data could provide a foundation for future studies of the effect of new endorsements on institutions of higher education. For purposes of analysis, regulations have been placed in three groups: 1) two-year institutions, 2) small colleges with enrollments under 1,800 students, and 3) large colleges.

**Two-Year Institutions**

Since an ever increasing percentage of young people begin to prepare for the teaching profession in two-year institutions, these schools play a vital role in teacher preparation. Most two-year schools offer a variety of basic science courses that can fulfill broad-field certification requirements. Survey results suggest the following conclusions in regard to the single-subject endorsement:

1. Of the six private two-year institutions in the state, only one offers any acceptable course.
2. All nine state-sponsored community colleges offer at least one relevant course. In three of these state schools it is possible to complete eighteen, or more, quarter hours of course work that should fulfill single-subject certification requirements.
3. In two-year institutions, integrated programs in earth and space science are apparently rare. Courses are administered by different departments and content may not be co-ordinated. From data we appraise but there appears to be a shortage of laboratory-based investigative courses.

In an overview, many state-supported two-year institutions are offering relevant course work to potential teachers and in-service teachers can also utilize these programs.

**Small Colleges**

There are 25 accredited colleges in Tennessee with enrollments of fewer than 1,800 students (HEW, 1973). Some cooperate with nearby schools to provide broad programs for their students. It is, therefore, difficult to characterize course offerings and their potential for certification. Data obtained from each school were accepted as scientifically accurate.

In small four-year institutions that offer earth and space science, the administrative focus of courses is generally in the Science Department. No school offers a major or minor in earth and space science or in any subsidiary field. One school does offer concentrations in both geology and earth science for prospective elementary school teachers.

Course offerings in small four-year schools generally include either "Physical Geography" or "Conservation of Natural Resources". These courses are transferable programs in agriculture. Thus, they need not indicate a school's orientation toward earth and space science. For this reason "Physical Geography", "Conservation of Natural Resources", and "Soils" are omitted from all tabular reports. The incidence of other earth and space science courses in small colleges is shown in Figure 1. (See Figure 1.)

Five small schools can probably graduate a teacher who meets broad-field certification requirements. As Figure 1 suggests, many schools have programs that are within one, or two, courses of qualifying for this certification. At present, none of the smaller colleges can graduate a teacher who meets single-subject requirements. Several offer year-long courses in earth science or geology. Although geology lies within the expertise of many professors, few schools offer courses. Perhaps limited interest in the subject will change as a result of new endorsements in earth science. In an overview, six of twenty-five small colleges offer some coursework in earth and space science beyond courses that fulfill pre-professional requirements in other fields. Five can probably graduate a teacher who meets broad-field requirements for certification. Although no school can now graduate a teacher with single-subject certification, several could meet requirements with small additions to current curricula.

**LARGE INSTITUTIONS**

As might be expected, large schools offer the greatest abundance and diversity of courses in earth and space science. Most large schools offer all courses that are conventionally required in other programs; "Physical Geography", "Conservation of Natural Resources", and "Soils." Figure 2 demonstrates the incidences of more specialized earth and space science courses in the 13 large institutions. (See Figure 2.)

**SUMMARY AND CONCLUSIONS**

1. A new program of teacher certification in earth and space science was announced by the Tennessee State Board of Education in February, 1973 and will become effective in February, 1974.
2. Certification appears desirable because 141 public school systems in Tennessee have adopted a plan to adopt an earth and space science text. There had been no previous official statement, from the Board, of acceptable minimum teacher preparation standards in this field.
3. New certification programs are broadly based, requiring either extensive preparation in all of the sciences or a blend of course work in geology, physical geography, meteorology, and options.
4. State minimum certification requirements are realistic and potentially effective, only if colleges offer relevant coursework.
5. Private two-year institutions do not offer a significant number of courses.
6. Most state-sponsored community colleges provide the prospective teacher with a reasonably broad introduction to the field.
7. Programs in five small four-year colleges appear to meet requirements for broad-field certification.
8. At present no small college can graduate a teacher with single-subject certification, but several schools could qualify with minor changes in curricula.
9. All but one of the large colleges can now graduate teachers who meet requirements for broad-field certification.
10. Five large schools can now graduate a student with single-subject certification requirements.
11. Five large schools require one additional course to meet single-subject certification requirements.
12. This article records the results of a survey made prior to the implementation of new endorsements. Comparable surveys in future years could show the impact of new endorsements upon post-secondary institutions.

**APPENDIX 1**

ENDORSEMENTS IN EARTH AND SPACE SCIENCE

Each endorsement is here presented as it was approved by The State Board of Education and as it will appear in the next edition of "Tennessee Regulations for Certification of Teachers.

**BROAD-FIELD ENDORSEMENT**

"The applicant shall offer a minimum of forty-eight quarter hours of credit in the sciences (biological science, chemistry, physics, and earth and space science) with at least three areas represented. The applicant will be certified to teach those sciences in which he has completed a minimum of twelve quarter hours of work. When any two endorsements representing both the physical and the biological science fields appear on the certificate the holder will be certified to teach general science. If survey or integrated courses in the biological or physical science fields are provided by the training institution these may be included in the required forty-eight hours.

To explain the asterisk, the following footnote will appear in the regulations: "Earth and space science includes physical geography, geology, astronomy, meteorology, and oceanography."

**SINGLE-SUBJECT ENDORSEMENT**

"For endorsement in earth and space science, twenty-four quarter hours which must include:
1. nine quarter hours of geology
2. three quarter hours of physical geography
3. three quarter hours of astronomy
4. State minimum certification requirements are real