ciation, the Tennessee Ornithological Society, Kappa Delta Pi educational fraternity and Sigma Xi.

Dr. Bottum was made an Honorary Member of the Tennessee Academy of Science in 1954, and a Fellow of the Academy, posthumously in 1958.

She did most of her research in the morphology of the seed plants. She contributed frequent papers to the *Journal of the Tennessee Academy of Science* and to the *Botanical Gazette.* She remained active in research after her retirement and while living in Seattle.

Dr. Bottum will be remembered by her students and associates as a most stimulating and thorough teacher, unselfishly devoted to the teaching profession and to the advancement of science.

High School Science Section

FOURTEENTH TENNESSEE SCIENCE TALENT SEARCH

HANOR A. WEBB
George Peabody College for Teachers, Nashville
AND
JAMES L. MAJOR
Clarksville High School, Clarksville

Tennessee scientists and science teachers take a just pride in the recent achievements of fourteen high school seniors, 16 and 17 years of age, who have been rated "notably talented in science" by the judges of the Eighteenth National Science Talent Search, as announced from Washington, D. C., in March.

Congratulations are also due sixteen additional school seniors who have been honored in the list of the Fourteenth Annual Tennessee Science Talent Search, which follows the National competition.

The National Search for science talent is administered by Science Clubs of America, a division of Science Service, Washington. It is financed by the Westinghouse Educational Foundation, The Tennessee Search is sponsored by the Tennessee Academy of Science through its Talent Search Committee.[1]

Of chief interest is the news that one Tennessee student won the Grand Award in the National Search, a $7,500 scholarship for future study in the college of his choice. He is John Sey-

[1]The Committee: Thomas C. Barr, Jr., Tennessee Polytechnic Institute, Cookeville; Calvin A. Buehler, University of Tennessee, Knoxville; James F. Key, George Peabody College for Teachers, Nashville; James L. Major, *Chairman,* Clarksville High School, Clarksville; Hanor A. Webb, George Peabody College for Teachers, Nashville; J. H. Wood, University of Tennessee, Knoxville.

mour Letcher, Jr., of the Baylor School, Chattanooga. His teacher is J. Edmon Bradley. Another winner from the State was Leonard Daniel Massey, Jr., of McCallie School, Chattanooga. His teacher is Paul D. Greer. His prize was $250 in cash.

Last autumn, 76 alert high school science teachers of Tennessee requested 739 sets of examination papers from National headquarters. Of these, 123 completed their entries, which included a searching examination testing scientific reasoning, a superior record in high school subjects, and a detailed report of an original scientific research project. These documents were sent to Washington in December. In late February two Tennessee students were invited to Washington, joining a group of forty "winners" with all expenses paid. Twelve other Tennessee students were given Honorable Mention for their reports. As a climax, at the Awards Banquet in Washington, Letcher received the Grand Award and Massey a generous prize.

Every numerical figure in the above paragraph is a new record for Tennessee. Only seven other States had an equal or greater number receiving honors in the National Search. Throughout the Nation a total of 28,195 seniors took the test, but only 4,274 completed it. This proves how rigorous was the examination, and how carefully the reports were scrutinized. Those who "passed" have talent!

John Letcher built an experimental linear induction accelerator designed to hurry electron particles along their beam. Next fall he plans to enter California Institute of Technology, where "atom smashers" of great variety have been developed. Leonard Massey constructed a device for instantaneous transliterative communication, dealing with certain problems of automatic translation from one language to another.

All documents from Tennessee were returned from Washington, and evaluated by Drs. Buehler and Wood at the University of Tennessee. The Academy is indebted to these gentlemen for their facilities and labors in this statistical chore. The thirty highest scores, and presumably the students with the greater talent in science, are included in the following list in the *order of their rank in the scoring.*

For each individual the sequence is as follows: (a) name of student, (b) name of teacher, (c) name of school, (d) city or town, (e) concise title of the original science project. An asterisk (*) indicates Honorable Mention in the National Science Search.

1: (a) John Seymour Letcher, Jr., (b) J. Edmon Bradley, (c) Baylor School, (d) Chattanooga, (e) Experimental Linear Induction Accelerator Winner, Grand Award, $7,500 scholarship

2: (a) Leonard Daniel Massey, Jr., (b) Paul D. Greer, (c) McCallie School, (d) Chattanooga, (e) Instantaneous Transliterative Cimmunication. Winner. $250 award, National Search.

3: (a) *Pierce S. Corden (b) Sister Hyacinth, (c) Notre Dame High School, (d) Chattanooga, (e) Electriluminescent Panels.

4: (a) *Burton J. Krohn, (b) Jacquelyn Ann Turner, (c) Hillsboro High School, (d) Nashville, (e) Ozone on Sodium Hypochlorite.

5: (a) *Robert Lee Baxter, (b) Marion C. Bruse, (c) Haywood County High School, (d) Brownsville, (e) A Lunar Probe.

6: (a) *Robert M. Mason, (b) Sam J. Murray, (c) Madisonville High School, (d) Madisonville, (e) Electronic "Bug" to Follow a Painted Line.

7: (a) *Nathan W. Dean, (b) Howard Motychak, (c) Elizabethton High School, (d) Elizabethton, (e) Effect of Radioactivity on *Euglena gracilis* and *Paramecium caudatum*.

8: (a) *Frank H. Pollard, (b) Angie M. Perry, (c) Oak Ridge High School, (d) Oak Ridge, (e) Movement of a Focal Point.

9: (a) Michael F. Nolan, (b) Sister Hyacinth, (c) Notre Dame High School, (d) Chattanooga, (e) Construction of a Cupola.

10: (a) Richard Lloyd Frye, (b) C. A. Browning, (c) East High School, (d) Knoxville, (e) Magnetic Repulsion.

11: (a) *William C. Duckworth, (b) Jere Warner, (c) McMinn County High School, (d) Athens, (e) Temperature Effects on Solution Concentrations.

12: (a) *John Sam Caldwell, (b) Mrs. Burt R. Francis, (c) Isaac Litton High School, (d) Nashville, (e) Generation of Fluorides.

13: (a) James E. Byer, (b) Lula Mae Shipe, (c) Ceutral High School, (d) Knoxville (e) Graphing Equations with Three Unknowns.

14: (a) *Porter W. Johnson, (b) J. L. Rogers, (c) Tyner High School, (d) Tyner, (e) Binary Logarithms.

15: (a) Alvin J. Sanders, (b) John T. Johnson, (c) Young High School, (d) Knoxville, (e) A Formula for Discord.

16: (a) *James W. Mayo III, (b) J. D. Reding, (c) Treadwell High School, (d) Memphis, (e) Construction of a Six-Inch Reflecting Telescope.

17: (a) *Judith Ann Singer, (b) Dorothy F. Green, (c) Central High School, (d) Memphis, (e) AET and Radiation.

18: (a) Loriel Ann Safford, (b) Joe Minor, (c) Clarksville High School, (d) Clarksville, (e) Scientific Invention for the Modern Homemaker.

19: (a) Perry Rutledge Grace, (b) Dorothy F. Green, (c) Central High School, (d) Memphis, (e) Protection of the Frog against Whole-Body X-Radiation.

20: (a) Sam Bayless Upchurch, (b) Robert O. Beauchamp, (c) Peabody Demonstration School, (d) Nashville, (e) Geology of Middle Tennessee, Silurian Era.

21: (a) Harry D. McSwiney, (b) Mrs. Burt R. Francis, (c) Isaac Litton High School, (d) Nashville, (e) Spectral Study.

22: (a) George A. Holt, Jr., (b) Angie M. Perry, (c) Oak Ridge High School, (d) Oak Ridge, (e) A Theory of BI-Universal Cosmogenical Origin.

23: (a) Alfred Caldwell, (b) Sister Hyacinth, (c) Notre Dame High School, (d) Chattanooga, (e) Airfoils and Flight.

24: (a)*Carolyn J. Shafer, (b) Lula Mae Shipe, (c) Central High School, (d) Knoxville, (e) Color's Effect on Teen-agers' Preferences of Fruit Juices.

25: (a) Elizabeth Kirkpatrick, (b) Lula Mae Shipe, (c) Central High School, (d) Knoxville, (e) Pituitary Diabetes.

26: (a) John A. Walker, (b) John T. Johnson, (c) Young High School, (d) Knoxville, (e) Size and Charge of Atomic Nuclei.

27: (a) Gerald P. Smith, (b) V. W. Cole, (c) East High School, (d) Memphis, (e) The Area Rule.

28: (a) Richard Glenn Counts, (b) Mrs. Robert L. Goddard, (c) Elizabethton High School, (d) Elizabethton, (e) Power by Separation of Molecules.

29: (a) Gary A. Bullock, (b) Mrs. Robert L. Goddard, (c) Elizabethton High School, (e) Anti-Gravity Craft.
30: (a) James Price Foster, (b) John R. Blair, (c) Oak Ridge High (d) Oak Ridge, (e) Effects of Radiation on the Chicken Embryo.

The Tennessee Academy of Science has no cash awards or other gifts to present these talented young people. The list of their names, and an accompanying recommendation, is sent to a large number of colleges and universities in Tennessee and other States. Many of these, desiring to make the best investment of their scholarship funds, are able to offer suitable Freshman Scholarships. In past years, practically every student called "talented in science" by the Academy has attended college, usually on a helpful scholarship.

Interest on the part of high school science teachers, and their best students, was at a record high in respect to the Fourteenth Annual Tennessee Science Talent Search. May we predict that interest and participation in the Fifteenth Search will be even higher?

STRESS — BASIC ORIGIN OF DISEASE

BARBARA CONWAY
Notre Dame High School, Chattanooga, Tennessee

During the year of 1956 four people in my family were taking tranquilizers (Miltown or Equanil) for three different reasons prescribed by three different doctors. I therefore decided to investigate these tranquilizers and what they do. About this time my Science Club sponsor gave me a magazine article about the new book "The Stress of Life" by Doctor Hans Selye. My project is therefore a combination of these two subjects.

Stress is every outward event and internal emotion that bears on man or animal. The body's first reaction to stress in the immediate preparation to adapt to circumstances. First, there is shock; blood pressure, blood sugar and body temperatures drop immediately. Second, the brain sends a message to the pituitary gland. Third, the pituitary hurries an increased supply of its hormone, ACTH, to the adrenal glands. And fourth, the adrenals speed up the supply of corticoids to all parts of the body to bring about the temporary resistance to stress. After continued stress, exhaustion follows and the resistance is lowered, the adrenal glands enlarge, and the stomach develops ulcers. Some diseases caused by stress are: arthritis, kidney disorders, high blood pressure, mental illness and ulcers. Medicine can supplement nature's defense against stress by administering the pituitary gland hormone, ACTH, the adrenal gland hormone, Hydrocortisone, etc. to protect the glands from stress. Stress can also be treated with tranquilizing drugs and

This paper was presented at the meeting of the Junior Academy in Memphis, December, 1957.

large doses of vitamins. The key to a less stressful life is self-knowledge. Look for signs of being keyed up too much, learn to stop in time and learn just how far you as an individual can go.

I then began experimenting with albino hamsters, rats and mice.

Experiment I

One male albino hamster was placed in an empty metal cage on the cold concrete basement floor for two hours a day during which time his food was put in a closed contained where he could see and smell it but could not eat it. This caused a great deal of muscular exercise. He became stiff but revived when put near heat. He was placed in a small cage, which was tilted in a very odd position. He was extremely over-active in this cage and died the next morning. After seven days of stress his thymus gland became smaller, his adrenal glands larger and much darker, and his stomach became ulcerated, therefore smaller than normal.

Experiment II

One male white rat was also put in an empty metal cage on the basement floor. He became very active but was stiff that evening. It took me three hours to revive him by placing the cage over a warm register. Any time I would take him away from heat his ears, eyes, feet and tail would turn white instead of the normal pink color. The third day when I placed him on the basement floor for two hours he became stiff, revived only slightly and died in my hand. Except for the testes, which were raised, the other organs were changed the same as those of the hamster.

Experiment III

One male white rat was given two milligrams of Hydrocortisone, the adrenal hormone released during stress, for three days. I then changed the dosage from two to one milligram for two more days because I learned that two was an overdose. I then placed him in an empty cage on the cold basement floor. At the same time I was stressing him I gave him four hundred milligrams of Miltown for three days. I then changed the dosage from four hundred to two hundred milligrams of Miltown for three more days, continuing the stress, after which I chloroformed him. Instead of becoming stiff as the other animals had done during stress, this animal appeared and acted perfectly normal. As a result of the pre-treatment of Hydrocortisone and the treatment of Miltown while stressing him, the organs showed practically no change from a normal animal. The only slight change was one testis was partially raised.

While I was performing these experiments I read in the newspaper two interesting articles; 1) Dr. Herman Bundeson

stated: "Severe emotional stress experienced by some expectant mothers during early pregnancy may be linked with cleft palate, harelip and other congenital abnormalities of the newborn baby." After investigating two hundred thirty-two cases of harelip and cleft palate, they found that most of the mothers had suffered some kind of stress during the eighth to the tenth week of pregnancy. 2) Cortisone given to pregnant mice, early in the embryos' development, can cause offspring to be born with cleft palates. I therefore decided to make these experiments.

Experiment IV

One female white mouse was stressed in a metal cage in the refrigerator for two hours for three days. Since time was running out I performed a Caesarian Section only to find that the female was not even pregnant, but instead she had a loop of intestine which was enlarged and swollen and gave the appearance of pregnancy. This intestine looked almost exactly like the picture from Selye's book "Stress" which is reproduced on my left poster. However in my disappointment in not finding cleft palate babies, I descarded the mouse, intestine and all. In an attempt to duplicate this intestine I have stressed, killed and dissected five more mice, and the small male intestine in my exhibit is the closest to the original intestine I discarded.

Experiment V

One female mouse was stressed for seven days in hopes that she would produce cleft palate babies. I placed this female in an empty cage in a refrigerator at a temperature of thirty-eight degrees for two hours on the third to fifth and the thirteenth to seventeenth days of pregnancy. Four babies were stillborn, two of which had cleft palates.

Experiment VI

One female white rat was given one and one-half milligrams of Hydrocortisone in pieces of cheese for nine days from the sixth to the fourteenth day of pregnancy. On the twenty-first day she delivered thirteen babies, two of which were stillborn, one had a cleft palate, but the other eleven were disgustingly healthy.

Experiment VII

One female mouse was placed in an empty cage in a refrigerator at a temperature of thirty-eight degrees for from one and one-fourth to four hours on the seventh through the nineteenth days of pregnancy. On the twentieth she delivered nine babies one day early. Two babies had cleft palates, one of which had a completely joined upper lip which is the opposite of the normal hairlip of a rodent. There were even more serious deformities than cleft palates in this litter which I am planning to use in my 1958 exhibit.

Dissected specimens and enlarged pictures from all my experiments are shown in my exhibit.

In conclusion I have proven several different things. First, I have proven that stress caused changes in the thymus and adrenal glands, testes and stomachs of my rats and hamsters just like the pictures in Selye's book "Stress" as reproduced on my left poster. Second, pre-treatment with Hydrocortisone and treatment with tranquilizers during stress protect the glands and stomachs from injury. Third and finally, in three out of three cases where the female has either been stressed or treated with Hydrocortisone, some of the babies were born with cleft palates and even more serious deformities.

In continuing my work I hope to discover something which may be of benefit to this generation as well as future generations by finding possible preventions of congenital malformations through studying and experimenting on some causes of them. Personally I can think of nothing I enjoy more than working with science.

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EXPERIMENTAL TERATOLOGY

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My next door neighbor has a malformed little girl five years old who was born blind in one eye as the result of her mother having a very bad case of "flu" in the second month of pregnancy. This started me thinking, "If I could prevent only one case like this, it would be worth a great deal to mankind."

Early in the same year of 1957 when I was working on a science project entitled "Stress – Basic Origin of Disease", I read in the newspaper two very interesting articles regarding stress and cortisone as being causes of cleft palate and harelip in humans and mice. A little later my Science Club sponsor gave me an article on Congenital Malformations in the October 1957 Scientific American Magazine. My exhibit therefore shows over a year's research on Teratology. My objective is to find possible preventions by studying some causes in this new field of preventive medicine.

Teratology is a branch of science dealing with congenital malformations; environment during pregnancy is also an important factor. This factor has not always been recognized. A few scientists, such as Stockard in 1921, were experimenting on this idea, but it was not generally recognized until after the 1941 epidemic of Rubella (German measles). By environment pregnancy is meant surroundings, conditions or influences which

effect the unborn fetus (infant). Some of these environmental factors are: Rubella (German measles), deep anesthesia, X-ray, long airplane flights, certain drugs, diet (vitamin deficiency), accidents and emotional tensions.

Here are five possible precautions which can be observed during pregnancy as possible preventions of congenital malformations:

1. Some serious eye defects and mongolism (retarded minds) may be prevented by controlling Rubella (German measles).

2. Some blindness, mongolism, and cerebral palsy may be prevented by avoiding deep anesthesia (surgery and major dental work.)

3. Various deformities may be prevented by avoiding X-ray and long airplane flights (oxygen deficiency).

4. Some cleft palates, skeletal and internal defects may be prevented by paying close attention to diet (vitamin deficiency).

5. Some mongolism may be prevented by close attention to pregnancies of older women.

This is a new field of preventive medicine called "Prenatal Pediatrics" which concerns unborn children in their mothers' wombs.

I then began experimenting with pregnant white rats and mice.

Experiment I.

One pregnant white rat was given one to three milligrams of hydrocortisone for fourteen days from the sixth to the twenty-first day of pregnancy. On the twenty-first day of pregnancy she delivered four babies thre of which had malformations. There were three with undescended testes and one of the babies with the undescended testes also had a malpositioned heart. These babies were sacrificed and dissected on their sixty-eighth day.

Experiment II.

One pregnant white rat was shocked in the refrigerator twice on the second and tenth days of pregnancy for eight hours at thirty-eight degrees Fahrenheit. On the twenty-first day of pregnancy she gave birth to ten babies. As a result of this environmental factor eight of the ten babies were malformed, the rarest of which was a hermaphrodite, an animal which has both the male and female sex organs. This animal has two female ovaries and uterus and two male prostate glands. The proof of this is a pathology report from a well-known Pathologist in Chattanooga, Tennessee, at the Baroness Erlanger Hospital, Dr. Jack Adams. Five babies also had undescended testes and one a malpositioned heart. There was even a liver which was diagnosed as "fatty degeneration of the liver" by Dr. Jack Adams. These babies were sacrificed and dissected on their thirty-first day.

Experiment III.

One pregnant mouse was shocked in the refrigerator for eight hours at thirty-eight degrees Fahrenheit for two days on the sixth and thirteenth days of pregnancy. On the twenty-first day she gave birth to four babies. One of these four babies had malpositioned testes. These babies were sacrificed and dissected on their thirty-first day.

Experiment IV.

One pregnant rat was operated on the ninth day of pregnancy, December 23rd, 1957. In the operation I removed amniotic fluid from four yolk-sacs attempting to cause congenital malformations. During the operation she ceased breathing, but I revived her by inhaling and exhaling through a rubber tube held over her nose. About thirteen days later she gave birth to eight babies. As a result of this operation three babies were deformed, one with a malpositioned heart and two with malpositioned testes. These babies were sacrificed and dissected on their fifty-eighth day.

In eighty-five percent of rats and normal descent of testes is eighteen to thirty-one days; the range is thirteen to fifty-one days.

Experiment V.

One pregnant mouse was shocked in the refrigerator at thirty-eight degrees Fahrenheit for thirteen days from the seventh to the nineteenth days for from one and one-fourth to four hours. On the twentieth day, one day early, she gave birth to nine babies had malformations. Two were born with cephelhematomas (blood tumors of the brain), and one was born with no skin covering over his skull. These babies were stillborn.

Experiment VI.

The same mouse in another pregnancy with the same male had no unusual environmental factor. As a result of this all four babies had apparently normal heads. These babies were sacrificed when they were two hours old.

These malformed, dissected specimens as compared with normal specimens of the same age, pathology reports, and enlarged pictures from all my experiments are shown in my exhibit.

In conclusion I have shown in four out of four cases where the pregnant female has been subjected to various environmental factors, at least one of her litter has been born malformed, and in one case where the same mother was not subjected to any unusual environmental factor, the litter was apparently normal.