tion reduction potentials in the neighborhood of the
ones showing partial reduction are closely related
chemically to the latter.

LYLE V. BECK

ROLLER CANARY SONG PRODUCED
WITHOUT LEARNING FROM
EXTERNAL SOURCES

Since May 31, 1934, twelve roller canaries have
been born and reared in soundproof cages, without
hearing a song from any non-isolated bird. Eight are
males, and four are females. Daily recordings of
their vocal responses have been made on aluminum
disks, motion picture films, or strobophotographic
records.

The contest roller canary song consists of vocal
effects known as rolls and tours. They are distin-
guished on the basis of sonance, or successive auditory
fusion. In a roll, the successive pitch changes are
perceived as unitary, whereas in the tour the patterns
are perceived as discrete units. Physically, the dis-
tinction is one of rate of the successive patterns,
the rolls having sufficient rapidity to be fused in auditory
perception.

The basic song consists of a sequence of hollow roll,
hollow bell, schockel, flutes and water roll. The first
four, when graphed for rate of successive patterns,
show a decreasing rate resembling a typical muscular
fatigue curve. The rolls and tours of the main
sequence are added to, substituted for or embellished
by individual birds. The added effects are the bass
roll, glucke, glucke roll, water glucke, schockel, deep
bubbling water tour, bell roll, bell tour and bell
glucke. It is rare that a single bird has all the effects
in his song. The number generally varies from five to
ten.

By January 7, 1935, the date of this writing, all the
isolated males had produced recognizable effects of
the roller canary song. These data have been checked
by Mr. Frank H. Biere, of Whittier, California, an
outstanding contest judge.

Nest 1. Males 51, 52 and 53, each aged 212 days,
produced a hollow roll, schockel, flutes and water roll.
Males 52 and 53 produced a hollow bell, and
Male 51 a bass roll, bell roll and bell tour.

Nest 2. Male 24, aged 210 days, produced a
schockel, flutes, water roll, hollow roll, deep bubbling
water tour and water glucke.

Nest 3. Males 56, 57 and 58, each aged 163 days,
sang a water roll and flutes. Males 56 and 57 devel-
oped a glucke and bell roll. Males 56 and 58 pro-
duced a hollow roll and schockel. Males 57 and 58
produced a water glucke. Male 56 the only bell tour
in the nest, and Male 58 the only water glucke which
has yet appeared in Nest 3.

Nest 4. Male 60, aged 224 days, produced a glucke,
flutes, bass roll, hollow roll, hollow bell and bell
glucke.

Taken together, the isolated birds produced all the
effects. Four of them, Males 51, 52, 53 and 60, had
from four to six effects when breaking into the mature
roller song for the first time. They were subjected
to inhibiting factors incidental to the original experi-
ment, possibly the excessive heat, or, perhaps in the
case of the first three, the fighting which often occurs
when males are in the same cage. The other four,
Males 24, 56, 57 and 58, developed one roll and tour
after another from their baby song. The latter three
were isolated at the first appearance of baby song,
before any roll or tour appeared. The baby song is
for the most part a nonsense melody of choppy notes
covering a wide pitch range. The earliest baby song
appeared at 60 days and the latest at 149 days.

Rolls appeared earliest in the cases of Males 51 and
52, specifically, at the age of 110 days. The slowest
to develop a roll was from the same nest, Male 53, who
was 179 days old at the time.

Males 24, 51, 56, 57, 58 and 60 heard no rolls or
tours of any kind prior to producing them. Males 51
and 52 heard each other. Male 53 heard the song
of Male 24.

The females have produced only a characteristic
chirp and simple series of call notes. According to
professional canary breeders, the female rarely has
any of the rolls and tours. With this assurance, the
mothers in this study were left with their young until
weaned, the period varying from 25 to 40 days. The
notes of the canary hens were observed and recorded,
and no semblance of rolls or tours appeared. The
males used in breeding were removed from the sound-
proof cages before the female was placed with the
eggs. The eggs were removed from the breeding cage
daily until all had been laid.

MILTON METTSEL

PSYCHOLOGY LABORATORY
UNIVERSITY OF SOUTHERN CALIFORNIA

BOOKS RECEIVED

108. Cambridge University Press, Macmillan. $2.00.

BOYD, T. A. Research: The Pathfinder of Science and

DODD, STUART CARTER. A Controlled Experiment on
American University of Beirut, Lebanon Republic.

FISHER, LOUIS F. Experiments in Organic Chemistry.

xi + 750. Harcourt, Brace. $5.00.

LIGGINGTON, R. W. and ROBERT H. SASHOR. Part I:
Studies of Laboratory Methods of Teaching. Part II:
Qualitative Aspects in the Improvement of Science
Arbor.

MYKLEWITZ, V. TH., Editor. Dynamo-Electric Machine
in Its Historical Development. Pp. xviii+ 560. 155
figures. Academy of Sciences Press, Leningrad.
the blood serum of convalescent influenza patients, but the serum taken from patients during their acute illness does not protect the mice against the disease. This latter finding, Drs. Francis and Magill state, seems to ‘show quite definitely that the virus is the causative agent of the human disease.’

PROSPECT of obtaining ‘heavy’ water which will allow large scale experiments with this rare and relatively new liquid was presented to the American Chemical Society. Dr. D. S. Cryder, of Pennsylvania State College, told how heavy hydrogen can be concentrated by distillation of ordinary steam. About a trillion pounds of steam are generated annually by the U. S. power and light industry and the 2,000,000 pounds of the now-expensive liquid would result if only one per cent. of this steam had its heavy water extracted. Dr. Cryder predicted that the new Penn State method would allow production of heavy water at less than $2 a gram, ten cents a drop, the present lowest price quoted by Norway where cheap electricity is available. The present method of concentrating deuterium-rich water is by electrolysis. Water with its hydrogen of the double-weight variety—deuterium to chemists—is useful in tracing chemical reactions which may lead to new chemical knowledge of great value to industry.

Caviar may be a delicacy to most people, but to children of Soviet Russia it may become a tasty substitute for cod-liver oil because, like the fish oil, it is rich in anti-rickets vitamin D. A daily dose of two teaspoons of caviar was prescribed for one month to a group of 20 babies suffering from rickets. Seventeen of the babies were completely cured by this epicurean treatment, according to a report made by Professor M. Lepsky. Caviar from sturgeon and carp-like fish was used in this experiment. The caviar of various fishes differs but slightly in composition, however, so it is possible that other kinds of caviar may prove equally effective as a cod-liver oil substitute.

CONCLUSIVE fossil evidence that an arm of the sea covered central New Hampshire for a period of from fifty to a hundred million years longer than geologists have previously believed has been found by Professor Marland P. Billings, of Harvard University, and Dr. Arthur B. Cleaves, of Lafayette College, Pennsylvania. Several hundred specimens of fifteen species of fossils positively identified as belonging to the lower Devonian epoch have been found by the two scientists in the vicinity of Littleton, northwest of the White Mountains and about ninety miles inland from the Atlantic coast. It had not been previously known that the sea in this period extended into New Hampshire, although its extension into other areas at that time had been ascertained. Fossils of the Silurian period, believed to have been about 400 million years ago and to have continued until the Devonian epoch, have previously been found in this area and told science that the sea was there at that time, but until the present discovery, no fossils satisfactorily identified as Devonian had been found in the region. Consequently the continuance of the sea in that area for fifty million additional years was unknown.

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