reinforcement on the fixed-ratio key provided a longer period of time in which simultaneous presses of the variable-interval key could occur.

Figure 1 is a graphic record of a complete daily performance. Responses cumulated against time give a curve whose slope depicts the moment-to-moment changes in the rate of pressing the key. Presses of the right key are recorded in the top curve (record A), and presses of the left key are recorded in the bottom curve (record B). The discontinuities in the top curve represent the resetting of the recorder pen when it reached the limit of its excursion. In order to give more compact presentation, the parts of the curve in record A are not pieced together. Because both records were taken simultaneously, a given distance along the abscissa represents the same point in time for both curves. The insert in the lower right-hand corner of the figure shows the coordinates and scale of the curves. The four slope lines in the insert indicate reference values for various rates of responding in responses per second. Reinforcements are marked by the short marks oblique to the curve. The lowercase letters above the curves are used to refer to details of the curve.

For the most part, the performances of the animal on both keys are similar to those that would develop singly without interference from the behavior on another key. Presses of the right key (top curve) tend to be sustained at 3 to 4 responses per second, while presses of the left key (bottom curve) occur at about 0.1 per second. The simultaneous reinforcement on the two schedules of reinforcement, however, produced deviations from performances that would emerge if these schedules of reinforcement were arranged singly. Major deviations from a normal fixed-ratio performance occur as low rates of responding, as in the segments marked *a* and *b*. The rate of pressing accelerates gradually in the segments marked *c* and *d*, instead of the normal abrupt shift from a pause to a high rate as in the segments marked *h* and *k*; and bursts of responding separated by brief pauses occur, as in the segments marked *g*, *i*, and *l*, where high rates of pressing are sustained, reaching values as high as six presses per second for brief periods. These performances may be compared with the segments between *e* and *f*, which show a normal fixed-ratio performance. Major deviations from a normal performance on the variable-interval schedule occur as brief bursts of responding at high rates, as at *m*, *n*, *o*, *p*, and *q*. These can be compared with the low, constant rate of responding that prevailed for most of the session, as in the part of the curve between *o* and *p*.

For the most part, the chimpanzee used its left hand on the left key and its right hand on the right key. In many instances, it pressed both keys simultaneously, despite the large difference in the rate of pressing on the two keys. Approximately one-third of the responses on the variable-interval key coincided with presses of the fixed-ratio key. Food that was received from reinforcement of responses on the left key was taken from the magazine and eaten while the animal continued to operate the right key in the characteristic manner. The extent of the disturbance can be seen by examining the top curve in the vicinity of the small arrows, which indicate the exact point of food delivery occurring because of reinforcement of responses on the other key.

The technique used in this experiment demonstrates a method which could be used for studying bilateral independence (as, for example, the hand independence exhibited by a pianist when his left and right hands play at different tempos) in an *animal* subject. The ability to maintain two different kinds of behavior simultaneously could also have application in the study of emotional side effects of some psychological variables. For example, the performance on one key could be used as a baseline for the emotional side effects of a change in the schedule of reinforcement on a second key.

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25 February 1957

Fat Weight and Fat Placement in the Female

The measurement of body fat relates to two distinct problems, the amount of fat (fat weight) and the distribution of fat (fat placement). Although considerable information has been gathered on fat weight and fat placement in the male, comparable data on the female are meager. One set of estimates of body fat for adult females was of necessity based on skin-fold measurements of English outpatients and extrapolations from body-fat determinations made on guinea pigs (*1*).

Standardized soft tissue x-rays were taken on 107 healthy, adult, American-born women, aged 20 to 60 years, with a mean age of 39. Comparable roentgenograms were made on 81 clinically healthy adult males, of equal age range and of a mean age of 40 years. The two groups were drawn from the same population. Fat-shadow measurements were made at the following sites: lateral arm, medial arm, deltoid "pocket," iliac crest, mid-trochanteric, lateral leg, medial leg, anterior leg, and posterior leg (*2*). All distributions involving fat were highly skewed: median rather than mean values are therefore reported.

Table 1. Comparison of subcutaneous fat thicknesses in adult males and females. The sex difference in fat thickness is significant beyond $p = 0.01$ except for the deltoid pocket and iliac crest.

Fat measurement	Median values (mm)		Fat ratio female/male
	107 females	81 males	
Lateral arm	6.2	4.4	1.41
Medial arm	6.6	3.5	1.89
Deltoid pocket	17.8	18.0	0.99
Iliac crest	19.0	19.2	0.99
Trochanteric	28.1	15.6	1.80
Lateral leg	7.4	4.8	1.54
Medial leg	10.9	6.0	1.81
Anterior leg	4.1	2.6	1.58
Posterior leg	13.0	7.0	1.86
Stature (cm)	162.5	176.5	
Weight (kg)	58.3	76.4	

The women exceeded the men in seven out of nine fat-plus-skin measurements, with female/male ratios for subcutaneous fat up to 1.89. The actual differences, which were all significant at $p = 0.01$ or better, ranged up to 13.5 mm for trochanteric fat (see Table 1). However, in two thicknesses (deltoid "pocket" and iliac crest) sexual dimorphism was not complete; here male fat thicknesses were absolutely but not significantly greater. This confirms other evidence that for particular subcutaneous fat sites there may be a reversal of the usual trend (*3*).

From the intercorrelation matrices, trochanteric fat emerged as the best single predictor of total fat for adult males, as previously reported (*4*); iliac crest fat had the greatest communality with other fat sites for the female. The weight of fat, fat values, and constants appropriate for each sex were then estimated, on an individual basis, using the prediction formula (*5*)

$$y = r \frac{\sigma y}{\sigma x} x$$

The estimated *median* weight of fat for the females was 13.7 kg, not markedly greater than the median of 12.6 kg for the males. Estimates based on other central fat sites were very similar.

While males and females did not differ notably in the weight of fat, relative to the total weight the sex difference was marked. The percentage of fat was estimated as 23.7 for the females and 16.8 for the males: on the basis of these figures, the females were approximately half again as fat as the males. Again, since female subcutaneous fat thicknesses were generally greater, but total fat was not notably different, it follows that the sex difference in the proportion of outer and inner fat is considerable. Women carry more fat on and less in their smaller frames.

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8 March 1957

Chemical Protection against X-radiation Death in Primates: a Preliminary Report

The ability of a wide range of biochemically active compounds to offer protection to the animal organism against x-radiation death has prompted a great deal of investigation in this direction within the past few years. Such compounds as β-mercaptoethylamine, 2,3-dimercaptopropanol, S2, β-aminoethylisothiuronium · Br · HBr (AET), and numerous others have shown a remarkable degree of protection in mice (*1*).

Outstanding among these compounds is AET. This drug is known to provide 100-percent survival at 30 days against a dose of whole body x-radiation which is 100-percent lethal in untreated mice. It has also been shown to offer more effective protection to mice than does β-mercaptoethylamine on an equimolar basis (*2*).

Considering the increased interest in the prevention of radiation death and the high degree of protection afforded the lower animals by AET, it seemed mandatory that further studies should be carried out in primates. This is a preliminary report (*3*) of work in progress to determine the protective effect of this drug in the monkey.

AET in doses ranging from 100 to 400 mg/kg of body weight has been given intraperitoneally to *Macaca mulatta* monkeys prior to the administration of a dose of whole-body x-radiation. At dose levels above 250 mg/kg, the toxicity of the drug is prohibitive when it is administered intraperitoneally as a single dose. However, the monkey can readily withstand 250 mg/kg in a single dose, if lower doses are administered over a period of a few days, and the doses are gradually increased from 100 to 250 mg/kg. A Westinghouse Quadrocondex 240-kv therapy machine with 1.0 mm Al plus 1.0 mm Cu filters was used for radiating the monkeys. At 240 kv, 15 ma, and a half-value layer (HVL) of 2.0 mm Cu, the machine delivers 13.25 r/min at 100-cm target distance. The animals were secured in a wooden chair which was rotated 4 times per minute in the x-ray beam.

Paterson (*4*), using *M. mulatta,* has found that 100 percent of the animals die as a result of 600 r of whole-body x-radiation administered in a single dose. The dose level of 650 r employed in this experiment, therefore, appears to be well above the LD_{100} and has resulted in the death of 100 percent of the untreated radiated control monkeys in this laboratory.

One animal was injected intraperitoneally on successive days with the following doses of AET: 100, 150, and 200 mg/kg of body weight. Three days after the 200-mg injection, the animal was given 250 mg/kg and was immediately radiated with 650 r of whole-body x-radiation. This animal is surviving at 280 days postirradiation and is apparently normal. A second monkey was injected intraperitoneally with 100 mg of AET per kilogram of body weight and 4 days later was given 150 mg/kg. Two days after the 150-mg injection, the animal received 200 mg/kg and was immediately radiated with 650 r of whole body x-radiation. This animal was surviving and apparently normal at 124 days when it was sacrificed for histological examination.

Peripheral blood studies of the two animals were indicative of the protective ability of the drug. By the fourth day postirradiation in both animals, the number of circulating blood cells was greatly reduced and remained at a low level until the 18th day. On the 18th day postirradiation, the circulating reticulocytes showed a dramatic steep increase in number, with an increase also in the number of circulating leucocytes. The increase in reticulocytes was followed in 4 to 6 days by a return of the hematocrit toward normal. The influx of reticulocytes began to subside by the 30th to 32nd days, and the entire peripheral blood picture had returned to normal by 65 days. In neither case did the peripheral blood picture reach the low levels observed in unprotected control animals that were irradiated at the same dose level.

These preliminary studies indicate that AET in doses of 200 to 250 mg/kg of body weight is capable of protecting the primate from x-radiation death when it is administered prior to irradiation. Expansion of this study is in progress both with regard to the toxicity of the drug and to its radioprotective ability.

Note added in proof. Since this paper was submitted, four monkeys have reached 30-day survival after having received 150 mg of AET per kilogram of body weight in a single dose prior to administration of 650 r of whole-body x-radiation. Peripheral blood studies of these four animals bear out the findings up to 30 days described in this report.

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25 February 1957

Control of Certain Forms of Zooplankton in Mass Algal Cultures

The most common difficulty experienced in growing phytoplankton on a large scale, in tanks of several-thousand-liter capacity, is the invasion of the cultures by various forms of zooplankton. In our cultures (*1*), the common offenders are crustaceans, especially the members of the subclass Copepoda. Upon entering cultures of such forms as *Chlorella,* these pests rapidly multiply to such an extent that they consume most of the plant cells, rendering the cultures worthless.

We have tried a number of measures to prevent contamination with zooplankton of open-air algal cultures or to free the cultures from these animals after they become established. However, this was usually impossible to achieve because some eggs, juveniles, or adults were either left behind or quickly reintroduced. Other workers (*2*) have reported contamination in their open-air algal cultures and also that attempts to exterminate the undesirable forms were practically unsuccessful.