portance of nonauditory cues. A blank pause on a tape record may represent a smile or sympathetic gesture by the therapist, the silent weeping of the patient, or innumerable other behavioral possibilities. Unless, as Kubie (*5*) recommends, a movie of the interview is taken, the visual impressions cannot be recorded for exact reproduction. So far, however, the technical difficulties in unobtrusively making sound movies of the psychotherapeutic process have not been overcome. For more fleeting impressions, one-way mirror observation is being widely used. This allows simultaneous direct observation by a number of observers, whose independently arrived at formulations may then be compared.

*Inferences and primary data.* There have been only a few studies (*13–16*) dealing with the problem of evidence in psychoanalytic propositions. From these it is apparent that detailed specific and concrete reports of the original data and the psychological and logical processes leading to inferences regarding such material are extremely rare. Actually, perusal of the psychiatric and psychoanalytic literature indicates that in a number of instances inferences by the therapist are treated as if they were primary data. Recognition of the unique features of the psychotherapeutic interview as a data-gathering situation does not, however, imply the theoretical inapplicability of the usual scientific criteria for evidence, or obviate the ultimate necessity for critical evaluation of data by independent observers. There are, of course, tremendous practical difficulties involved, and sound recording offers only the most elementary approach to many of these, especially to problems related to the identification of unconscious or partially conscious, unverbalized factors in the therapist and their influence upon, and interaction with, similar phenomena in the patient.

The recognition of limitations is not, however, a valid argument against the employment of new methods. Recordings permit study of the therapist's interpretations to patients and of his inferences made for the benefit of scientific colleagues. This medium will help to introduce a more rigorous operational approach, differentiating primary data, deductions, and inductions. As data become accessible to multiple observers, problems of agreement, reliability, validity, probability, and prediction may be studied. The differentiation between basic principles—if such exist—and individual practices based on common or uncommon sense and intuition is one of the important problems that may be studied with this method. Studies of the dynamics of the therapeutic process, variables in patients and therapists, and the evaluation of the total therapy should be within the realm of an objective approach.

Recordings may also be used in the evaluation of experimental organic therapies. The Yale Lobotomy Project is currently employing this technique in evaluating the dynamics of the interview situation with patients before and after prefrontal lobotomy.

One last word of caution should be added: The systematic analysis of sound recordings is an extremely time-consuming procedure. The procedure itself is at times uncertain and unsystematic unless a rather specific project is pursued and specific questions are asked. Such lack of system is one of the consequences of the absence of a universally accepted and satisfactory theory of behavior—notwithstanding some important beginnings in the creation of a science of behavior, such as the attempt to fuse concepts of psychoanalysis and learning theory (*11*) and H. A. Murray's approach (*12*). Improvement of procedure will lead to better theory, which in turn will permit a more systematic method in the complex science of normal and abnormal human behavior.

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## Some Effects of High Velocity Electrons on Wood


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It has been shown by others that ionizing radiation of suitable intensity will produce chemical changes in materials subjected to such radiations (*1–3*). The modification of a 1-mev pressure insulated resonance transformer-type x-ray unit (*4*) provided a source of high velocity electrons with which a dose was accumulated at the rate of approximately $0.14 \times 10^6$ equiv r/sec. Much higher doses are readily realized with this source than with the usual x-ray and radioactive sources.

Irradiation of basswood with high velocity electrons alters its structure in such a way that some of the


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insoluble carbohydrate components become available to rumen bacteria. The production of volatile acids from the incubation of irradiated wood samples with fresh rumen content was taken as a measure of digestibility by rumen bacteria (*5*). The effect of the irradiation of basswood on volatile acid production is shown in Fig. 1.

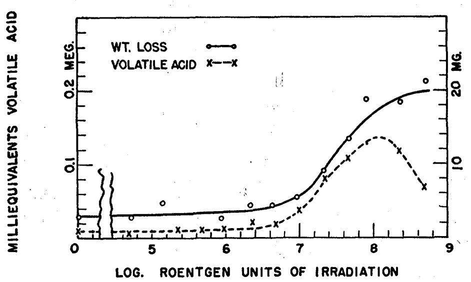


**Fig. 1.** Weight loss and volatile acid production of irradiated basswood incubated with rumen bacteria.

The cellulose in the untreated wood appears to be relatively unaffected by the enzymatic action of the rumen microbes, and digestibility is not much increased by irradiation up to $6.5 \times 10^6$ r. Between $6.5 \times 10^6$ and $1.0 \times 10^8$ r increased irradiation results in increased fermentability. At $10^8$ equiv r the maximum fermentability is reached, and the volatile acids formed constitute 79% of the amount found from an equal weight of filter paper. At this dose the digestibility by the rumen contents is comparable to that of hay. At the point of maximum digestibility the wood becomes hygroscopic and friable. The decrease in volatile acid production for doses greater than $10^8$ r can be interpreted to mean that the carbohydrate fraction of the wood has been converted to compounds that are not utilized by rumen bacteria.

Fig. 2 presents the results of assays for pentose, reducing sugars, and free phenolic groups on the soluble components of irradiated basswood. Phenolic groups were run on an alkaline extract of the treated wood. The pentose and reducing sugar were run on a water extract. It appears from these more sensitive tests that the treatment has degraded both the cellulose and lignin components of the wood in the range of optimum digestibility.

Microbiological tests and chemical analyses were run on control and irradiated cellulose (filter paper) and lignin (Scholler's process) to determine if the irradiation had its greatest effect on the lignin and thus exposed the cellulose of wood to bacterial action. Although the lignin appeared to be relatively unaffected by the irradiation, the results cannot be interpreted to mean that it is entirely unaltered, but merely that it is not greatly changed in a manner that is detectable by the chemical and bacteriological tests applied. The bacteriological tests on filter paper showed a decrease in volatile acids from samples irradiated with $3.35 \times 10^8$ r, which correlates with the decrease for basswood treated with the same dose (Fig. 1) and supports the interpretation that the de-

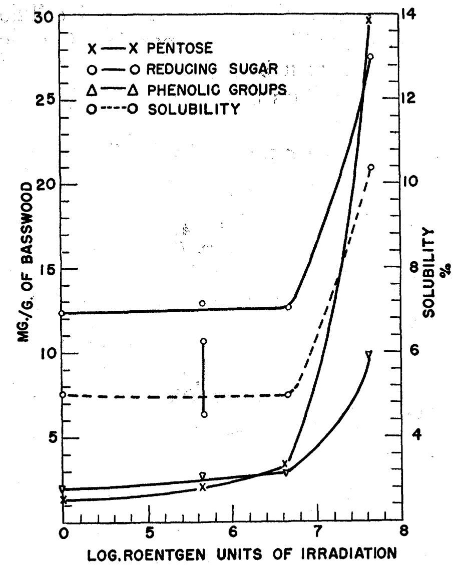


**Fig. 2.** Effect of radiation on soluble products of basswood. Pentose expressed as mg ribose, reducing sugar as mg glucose, and phenolic groups as mg tyrosine.

crease in acids formed from heavily treated wood samples is due to the destruction of the cellulose. At this dosage cellulose becomes almost completely soluble in water.

The formation of reducing sugars, in the case of cellulose, with increasing dose indicates depolymerization of the fundamental glucose chain. At the dose of $3.3 \times 10^8$ r, where the cellulose becomes completely soluble and where the production of fermentation acids starts to show a decrease, it can be estimated that the minimum chain length is approximately six $C_6H_{10}O_5$ units long. In the case of the wood, at this heavy dose, although cellulose is completely vulnerable to attack by the bacteria, it must be assumed that it is no longer in a form that can readily be fermented.

A reduction in particle size to the order of cellular dimensions (a fraction to 6 μ), where a larger fraction of the cellulose should be exposed to bacterial fermentation, did not significantly increase the bacterial attack on the unirradiated wood. This suggests that the relative indigestibility of the cellulose in the untreated wood is not due to an encrusting layer of lignin, as often postulated (*6*). It is possible that the lignin in basswood is of such a material that during the ball-milling it is smeared over the exposed cellulose surfaces to form a protective layer.

Alternative interpretations of the present results could be:

(*a*) There is a definite bond between the lignin and the cellulose which, in the natural state, rumen bacteria are unable to hydrolyze. It is the alteration of this bond by the irradiation that is responsible for the increase in digestibility.

(*b*) There are natural lignin bacteriostatic compounds or groups such as have been reported in cedar heartwood (*7*), which are destroyed by irradiation.

(*c*) The irradiation disrupts the natural cellulose of the wood, which, unlike filter paper, is not susceptible to digestion by rumen bacteria.

The present study does not favor or eliminate any of these possibilities.

This work will be reported in detail elsewhere.


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# The Determination of Cholinesterase Activity in Whole Brains of Developing Rats


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The cholinesterase activity of the chick brain has been determined by Nachmansohn (*1*). Later, Sawyer (*2, 3*) demonstrated the correlation between cholinesterase activity and motility of the developing embryo of *Amblystoma maculatum.* Using Sawyer's modification of the microtitrometric method of Glick (*4*), we have measured the activity of cholinesterase in the brain of the developing white rat. The experimental data from this investigation are shown in graphic form in Fig. 1.

The determinations were made on rats ranging in age from the 14-day fetus to the adult. In order to obtain embryos of known age, rats were bred during one night and the age of the fetus was considered to be one day at midnight of the first night thereafter. In the 14-day fetus, the earliest stage employed, the fetus weighed less than 0.1 g, and the entire top of the head was considered to be brain tissue. In 16-day

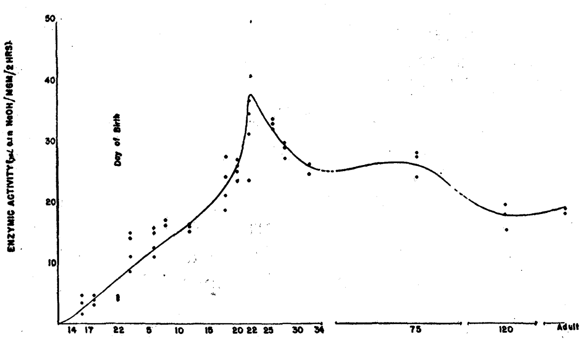


Fig. 1. Cholinesterase activity in the brain of the developing rat.

and older fetuses, the brain is sufficiently well outlined to allow removal by dissection.

The cholinesterase content of the 14-day, or earliest, fetal rat brain studied was less than the error of the method, but in the 16-day fetus a measurable quantity of cholinesterase was found. Although the rat fetus shows a considerable increase in size from the 16th day of gestation until birth, the activity of the esterase remains constant until the 2nd postnatal day. From the 2nd to the 22nd day after birth a rapid increase in the concentration of the enzyme is apparent. In contrast to this early increase, the activity of cholinesterase declines sharply from the 26th to the 32nd day, after which there is a gradual decline to the adult level, this being reached at about 120 days after birth.

In our study stages from the day of birth to the 32nd postnatal day were spaced about 2 days apart. In order to bridge the gap between the young stages and the adult, animals of about 2½ and four months of age were included.

The curve obtained when the activity of cholinesterase in the whole brain of the rat is plotted as a function of age is similar to the one shown by Sawyer (*2*) for *A. maculatum.* In his observations on early embryos, Sawyer used the whole brain and the spinal cord as far caudal as the level of the anus, whereas in studies of some of the later stages he made separate determinations on the brain and the spinal cord. Sawyer found that the activity of the enzyme was present to some small extent even before the larvae were motile, but that the activity began to rise sharply as the organism reached the swimming stage and continued to rise for several days after feeding had begun, reaching a peak about 20 days after initial feeding. From this point the curve declined, rapidly at first, and then more slowly during metamorphosis until it reached, late in development, the level characteristic of the adult. Sawyer found the rapid rise in the enzyme concentration during the early larval period to occur at a time when the larva shows maximum activity as indicated by rapid feeding reflexes and low threshold to external stimuli. The same author postulated that the decline in the activity seen in the adult was due to the development of esterase-diluting structures in the brain.

Our curve showing cholinesterase activity in the rat agrees well with the work of Sawyer. The immaturity of the rat at birth probably explains why changes similar to those found by Sawyer do not occur until the first weeks after birth; nor until 2 days after parturition does the enzyme activity in the rat begin to rise, and then it rapidly increases to a peak on the 22nd day after birth. By the 26th day the activity begins to decline. This decrease, like that found by Sawyer, can probably be explained by the formation of tissue that is not rich in cholinesterase. Angula (*5*) reports that the 14-day fetus is nonmotile, and from that time until birth there is a slight increase in ability to respond. Stone (*6*), reporting on the growth of responses in the postnatal rat, reports a rapid in-