of threshold and suprathreshold stimuli. Some investigators (*5*) have reported that in addition to the direct somesthetic sensory impulses going directly to the cortex there are secondary impulses that reach the cortex via the reticular formation. Perhaps stimulation at threshold may not activate this secondary system, although the possibility seems somewhat remote.

To study, next, the possible effect of suggestion, another experiment, in which different degrees of suggestion were utilized, was performed. In one group of eight subjects (the implicit suggestion group), each subject was read a statement to the effect that stimulation was to be applied to his teeth under conditions of noise and no noise, and that some people believed they would not feel a given amount of stimulation as much when the noise was on. Auditory analgesia was discussed extensively with another group, of 15 subjects (the explicit suggestion group), who were made aware that E_2 (who applied the electrode to the teeth) believed that they would not feel a given amount of stimulation as much when the noise was on. Broad-band noise at 120 db SPL was used.

Of the 48 possible scores in the implicit suggestion group, 2 were discarded because of no response at the highest setting of the vitalometer, 24 were positive, 16 were negative, and 6 were zero. Of the 90 possible scores in the explicit suggestion group, 4 were discarded due to lack of response, 45 were positive, 33 were negative, and 8 were zero. In neither suggestion group was the shift statistically significant. Even when scores for the two groups were combined, the rise in threshold, with noise, did not reach the .05 confidence level (χ^2 with $\eta = 1$). Again, no sex differences were found.

Thus, there is no evidence that noise reduces sensitivity when a tooth is stimulated electrically, and there is only a hint that suggestion may raise the threshold slightly. Of course one must, in interpreting the results, keep in mind the artificiality of the laboratory setting. In this tooth-vitality testing situation, subjects can be expected to focus their attention on the tooth being tested, thereby minimizing the effects of the third possible cause of the audio-analgesic effect—distraction. In addition, the attitude of the typical subject toward a test situation of relatively finite duration and his attitude toward an operative procedure of uncertain duration and unknown severity are probably quite different. It seems likely that the subject would respond more to suggestions of decreased sensitivity in the latter, more anxiety-arousing, situation. Perhaps the effectiveness of auditory analgesia in a clinical situation depends on both suggestion and distraction, acting jointly (*6*).

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References and Notes

1. W. J. Gardner and J. C. R. Licklider, *J. Am. Dental Assoc.* **59**, 1144 (1959).
2. H. Cherry and I. M. Pallin, *Dental Dig.* **54**, 455 (1948); W. J. Gardner, J. C. R. Licklider, A. Z. Weisz, *Science* **132**, 32 (1960).
3. P. P. Taylor, *Oral Surg. Oral Med. Oral Pathol.* **6**, 1020 (1953).
4. A. Z. Weisz, personal communication.
5. J. D. French, M. Verzeano, H. W. Magoun, *A.M.A. Arch. Neurol. Psychiat.* **69**, 519 (1953).
6. Supported by research grant D-1488 from the National Institute of Dental Research, U.S. Public Health Service.
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Gas-Flow Counting of Carbon-14 Compounds: An Improved Technique

Abstract. Reproducibility in counting by a gas-flow detector of duplicate samples of C^{14}-labeled compounds plated on glass planchets is much improved by spraying of the lower surface of the planchet with an "antistatic" agent in aerosol form. Count rates that decreased with time were eliminated by this treatment.

Recently it became necessary to determine accurately the disintegration rates of C^{14}-labeled samples of higher radioactivity than those previously used in our work. These samples were plated in very thin layers on glass planchets and counted in a windowless methane gas-flow detector operating in the proportional region at an absolute efficiency of 50 percent. With samples showing an activity of about 500 count/min, reproducibility between duplicate planchets approximated the statistical fluctuations (2 percent reliable error) expected from the total number of counts accumulated. With samples showing an activity of 50,000 count/min, however, not only was reproducibility between duplicate planchets far worse than could be explained by the random nature of the disintegration but also the count rates decreased with successive 1-minute counts.

Since the proportional detector was used in conjunction with a fast amplifier and scaler (resolution time, 0.8 μsec) and an electronic timer, coincidence losses or instrument errors could not account for these variations. The count rate, which decreased rapidly for the first few minutes then gradually ceased to change, was restored to its original higher value if a planchet was removed from the chamber with forceps, placed for a moment on any surface, such as a wooden bench or a hand, and replaced in the chamber. The count rate would then again decrease in a similar manner. If the planchet was removed from the chamber with forceps and replaced in the chamber without allowing the lower surface of the planchet to touch any other surface, the count rate immediately observed was the lower "equilibrium" rate. These effects were also observed when the same planchets were counted in another type of gas-flow detector which had a very thin window and operated in the region of the Geiger counter.

Similar types of errors have been noted by others when I^{131} was plated on cupped aluminum planchets (*1*), S^{35}, P^{32}, and Cs^{137} on planchets of copper, glass, aluminum, or steel (*2*), C^{14} on aluminum or brass planchets (*3*), and H^3 on nickel planchets (*4*). Various explanations of these errors have been offered (*4–6*) and remedies have usually involved some treatment of the upper surface of the planchet to render it conducting. Thus Spang and Gebauhr evaporated a thin layer of silver onto the planchet (*6*); others mixed colloidal graphite with the sample prior to its plating (*1, 3, 4*). These remedies have the disadvantage of contaminating the sample, a consideration that is important when the sample must be recovered after counting.

We have found that spraying the lower surface of a glass planchet with certain of the aerosol mixtures sold in music stores for removing the static charge from vinyl phonograph records completely eliminates the problem of count rates that decrease with time, so that counts on either the sample or duplicate samples may be reproduced with an error only slightly greater than that expected. The data in Table 1 show typical results obtained when a sample of C^{14}-labeled photosynthate from wheat leaves, plated from 80 percent aqueous ethanol, was counted in the proportional counter over a period of time and then recounted after the lower surface had been lightly sprayed

Table 1. Effect on the count rate of an "antistatic" agent applied to the lower surface of a glass planchet containing C^{14}.

Elapsed time (min)	Activity (count/min)	
	Unsprayed	Sprayed
1	59,112	58,774
2	58,346	59,418
3	57,257	59,565
4	55,906	59,389
5	54,864	59,344
6	54,834	59,077
7	53,833	58,963
8	53,812	58,993
9	53,433	59,529
10	53,162	58,914

with an antistatic agent (*7*). Similar results were obtained in the Geiger counter mentioned above.

At lower levels of radioactivity (500 count/min), the statistical fluctuations are too large for successive 1-minute counts to provide meaningful data regarding the possible existence of declining count rates. The average of count rates over 10 minutes, however, should be less for solutions on unsprayed than for sprayed planchets if the effect is common to all samples. To answer this question, the same solution used in the preparation of the planchet of Table 1 was diluted with 80 percent aqueous ethanol, plated on a glass planchet, counted in the proportional counter for 10 minutes, sprayed lightly on the lower surface, recounted for 10 minutes, and, finally, the lower surface was thoroughly wiped with a tissue to remove the spray, grounded to remove any electrostatic charge induced by the wiping, and again counted for 10 minutes. Count rates of 516, 541, and 514 count/min, respectively, were obtained. Since the planchet each time was placed in the same position in the chamber to eliminate geometrical effects, it is clear that the spray did affect the observed count rate at lower, as well as at higher, levels of radioactivity. Further tests in which calibrated $Na_2C^{14}O_3$ solutions (*8*) were used showed that with the sprayed planchets the count rates were consistently higher, and more accurate, than they were with the unsprayed planchets. That the effect of the spray persists for at least 6 months was shown by weekly counting on a sprayed planchet. Spraying the upper surface of the planchet either before or after plating the sample had no effect on the count rate decline.

With Br^{82} and Cs^{137}, nuclides emitting beta particles of considerably higher E_{max} than those of C^{14}, no such counting errors were encountered; indeed, the spray had no effect on the count rates of these nuclides when they were plated on glass, copper, or aluminum planchets. A slight but significant decrease in counting errors was noted when the spray was used for C^{14} plated on copper and aluminum planchets which had not been rigorously cleaned to remove grease prior to plating.

Not all of the phonograph record sprays tried effectively reduced the counting error. Two "antistatic" wiping cloths proved ineffective, and one of these was manufactured by the same company which produced an effective spray. Although there is considerable variation in the nature of the active ingredients *(9)*, the composition of only one of the sprays tested was determined *(7)*, and the active ingredient was found to be a quaternary ammonium compound.

The mechanism by which this compound decreases these specific counting errors is not clear. Whereas the upper surfaces of the glass planchets used were sand-blasted, the lower surfaces were smooth, and it is possible that the low energy beta particles from C^{14} may interact in some way with the nonmigrating negative ionic charge that was observed by Hubbard and Lucas on the smooth surfaces of silicate glasses *(10)*. Such interactions could distort the electric field within the counter. In any event, the use of an "antistatic" agent such as we have described simplifies the counting of C^{14} on glass planchets. The technique may also prove useful for other nuclides, such as H^3, that emit beta particles of low E_{max} and for planchets of different materials.

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References and Notes

1. A. F. Reid and M. C. Robbins, *Science* **116**, 148 (1952).
2. G. K. Schweitzer and J. S. Eldridge, *Anal. Chim. Acta* **16**, 189 (1957).
3. A. R. P. Paterson and S. H. Zbarsky, *Can. J. Biochem. Physiol.* **36**, 755 (1958).
4. T. E. Banks, J. C. Crawhall, D. G. Smyth, *Biochem. J.* **64**, 411 (1956).
5. D. N. Hume, *Anal. Chem.* **21**, 322 (1949); T. P. Kohman, *ibid.* **21**, 352 (1949); B. Sujak, *Czech. J. Phys.* **7**, 627 (1957).
6. A. Spang and W. Gebauhr, *Nukleonik* **1**, 160 (1958).
7. Walco Stati-Clean, Walco Electronics Co., Inc., 60 Franklin St., East Orange, N.J.
8. Nuclear-Chicago Corp., Chicago, Ill.
9. J. Eisen, U.S. Patent 2,680,080, June 1, 1954, to Monsanto Chemical Co.
10. D. Hubbard and G. L. Lucas, *J. Appl. Physiol.* **15**, 265 (1960).

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Poisoning by Organic Phosphorus Pesticides Potentiated by Phenothiazine Derivatives

Abstract. Repeated administration of the phenothiazine derivatives chlorpromazine and promazine increased the toxicity of a single dose of parathion in male rats. In female rats, a single dose of 5 mg/kg of promazine increased the toxicity of a single dose of parathion, but had no apparent effect on the toxicity of a single dose of Phosdrin. Repeated dosage with chlorpromazine and atropine, or promazine and atropine, after administration of parathion at the same rate, resulted in a slightly higher mortality in female rats than did atropine or no treatment.

In human patients and small animals phenothiazine tranquilizers (*1*) often increase the effectiveness of sedatives, analgesics, and narcotics (*2*). The possibility that promazine may potentiate poisoning in man by organic phosphorus pesticides was suggested by Arterberry *et al.* (*3*). On the other hand, Frada and Gucciardi (*4*) reported that treatment with chlorpromazine prolonged the survival time of guinea pigs poisoned with a mixture of malathion and parathion, but they did not indicate whether any of their treated animals survived. Other investigators have reported that a combination of atropine and chlorpromazine (*5*) or a variety of other phenothiazine derivatives (*5*, *6*) is more effective than atropine alone in preventing poisoning by sarin (*5*) or tabun (*6*).

Adult Sherman rats were used; the males weighed from 266 to 428 g and the females weighed from 175 to 300 g. Technical grade parathion, or 24.3 percent emulsifiable concentrate of Phosdrin, was diluted in peanut oil to the appropriate concentration and administered by stomach tube (5 ml/kg of body weight). Peanut oil alone was given to control rats which did not receive an organic phosphorus compound. Aqueous solutions of promazine and of chlorpromazine, 5 percent and 2.5 percent, respectively, were diluted with 0.9 percent sodium chloride solution to a concentration that permitted administration at a rate of 0.8 ml/kg of body weight. The tranquilizers were given by stomach tube or intraperitoneally. Sodium chloride was administered in like manner to control animals; atropine was given intraperitoneally. LD_{50} values were calculated by the method of Litchfield and Wilcoxon (*7*).

Groups of ten male rats were each given single oral doses of parathion. Each rat was then given 3.0 mg/kg