in sharp contrast to that of the control animals. They ate well, were moderately active, had no diarrhea or evidence of sepsis or hemorrhage. In some there was a slight local inflammatory reaction about the neck wound.

All animals that died in the treated and control groups showed depression of the hemopoietic tissues, widespread hemorrhagic manifestations, and, frequently, evidence of sepsis. In the occasional surviving control dog there was evidence of petechiae and ecchymoses in the cutaneous tissues.

Peripheral blood studies showed a depression of the total leukocytes to a mean value of 400 cells/mm^3 or less in the control group, whereas the cross-transfused group manifested a depression to only 1,800 cells during a corresponding period after irradiation (Fig. 1). The reticulocyte response in the control group was 0.2% or less in the entire post-irradiation period, whereas the cross-transfused dogs showed a response between 1% and 2% by the 15th day after irradiation (Fig. 2).

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Methane Gas in Water Well

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Methane gas was discoverd in small amount in a water well cable-drilled by the Steel and Hodgdon Company, of Auburn, Maine, about 3.2 miles northeast of the center of the village of Winthrop in Winthrop Township. The village is about 10 miles west of Augusta, Maine, and is shown on the map of the Augusta quadrangle published by the U. S. Geological Survey. The well site is located a few feet west of Highway 135, 1.2 miles north of its intersection with State Highway 100—the Augusta road. It is near the southern nose of a low ridge that runs approximately north-south midway between Carlton Pond (elevation 340′) and Lake Maranacook (elevation 210′, Fig. 1).

General groundwater conditions. Several swamps at elevations ranging from 200′ to 230′ above sea level are within a 0.5-mile radius of the well site. Water was encountered in a well 72′ deep (102′ above sea level) near East Winthrop, 1.8 miles southeast of the "methane" well site. One and one-half miles north of the well site several wells show water at average depths of 150′–195′ (or 200′ above sea level). In the methane well under discussion water was not encountered until a depth of 510′ was reached, or at 160′ below sea level. The methane gas was encountered at about 250′, but none was found below that zone.

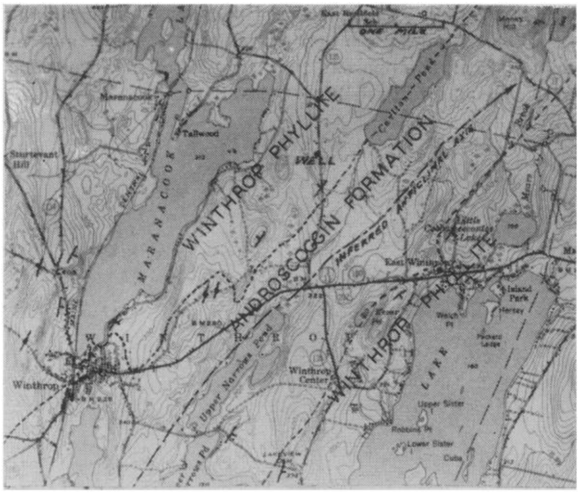

Fig. 1. Geographic location of methane well near Winthrop, Maine. Geologic formations and structures indicated.

Geologic conditions. Two sedimentary rock formations now in the middle grade zone of metamorphism (Fig. 1) are mapped in the area (*1*), and the contact between the two formations trends northeasterly through the southern end of the ridge 0.5 mile south of the well site. The Winthrop phyllite consists of two facies—one characterized by chloritoid (ottrelite), the other by garnet and some staurolite. Northward along the strike the phyllite passes into the low-grade metamorphosed Waterville shales of Silurian age. Underlying the Winthrop formation are the limy phyllitic beds of the Androscoggin formation, which is the nearest exposed formation to the well site. Both formations are part of a major syncline that strikes northeast and plunges slightly in the same direction. The Winthrop dark grayish-blue phyllite is fine-grained in surface exposures and is definitely foliated. Minute metacrysts of ottrelite, biotite, and a white micaceous mineral are visible. The limy phyllitic member of the Androscoggin is lighter gray in color than the Winthrop phyllite and includes visible calcite, biotite, and feldspar.

Study of well cuttings. Cable-drill cuttings taken from various depths (Fig. 2) along the wellhole show a marked change in color at a depth of about 325′. Samples from the upper portion of the wellhole are bluish-gray, and binocular examination indicated that the formation penetrated to that depth is the surface-forming Winthrop phyllite. Small chips from this portion of the well contain slender veinlets (0.5 mm) of calcite. Three % of 100-150-mesh fragments are heavier than 2.817 sp g (bromoform separation). Most of the heavy material is biotite. Screened well cuttings from 500′ show 5.5% heavy mineral, which is composed of biotite, graphite, and pyrite, with the first predominating. Acid solubility was determined, and results are as shown in Table 1. Based on observations of differences in color of the samples from the different depths, on mineral content, and on solubility, it is apparent that two different formations were encountered in drilling the well.

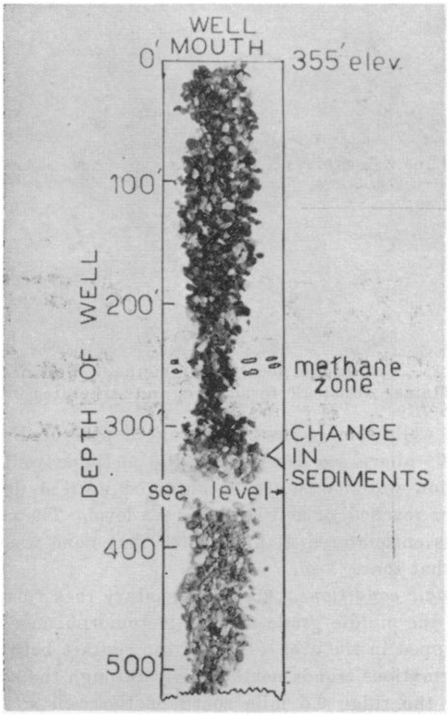

FIG. 2. Difference in lithology shown by well cuttings.

Methane gas pocket. Thayne Hodgdon, who supervised the drilling of the well, reported that no water was encountered in the hole until the depth of 500′ was reached. The water obtained at 500′ was decidedly cloudy but cleared after standing for about 5 hr. There was no oily film, but there was a decidedly gaseous odor and some bubbles. A sample of the water was brought to the Department of Geology at Bates College. Fisher made qualitative tests for chlorine, phosphate, and sulfur, finding an indefinite trace of the last. Sawyer identified the odor in the water as methane, or marsh gas. Several sterilized bottles were supplied Mr. Hodgdon, who returned to the well site for additional samples, and who subsequently reported that, when he ignited a match close to the bubbles issuing from the water, they exploded, and there was a blue flame of brief duration.

TABLE 1

Depth, ft	Sp g	Solubility in acid		Heavy minerals greater than 2.817, %
		1 : 4HCl, %†	1 : 2HCl, %†	
325	2.774*	4.4	9.7	3
500	2.803*	9.7	25.5‡	5

* = sp g determined by immersion method on 6 specimens from each depth.

† = 1 part acid in each acid solution; solutions were not heated.

‡ = vigorous effervescence and evolution of hydrogen sulphide.

Methane gas. Methane gas is found in many parts of the world, either pure or as the chief component of natural gas. The firedamp of mines, the sacred fires of the Chaldeans, the will-o'-the-wisp, or *ignis fatuus,* of the Irish bogs, and marsh gas are all methane. In the natural gas of commerce traces of heavier hydrocarbons and other substances may be mixed with the methane. No attempt was made in the case of the Winthrop well to test for other ingredients. The odor of the gas and the fact that it ignited and exploded sufficed to identify it.

Methane can be produced in the laboratory by a variety of methods. In nature it is the result of slow, anaerobic decomposition of organic matter, usually of plant origin. So far as the authors can ascertain, the only occurrence heretofore noted in New England is in bogs and in stagnant ponds, where it is commonly generated with the decay of vegetation buried in bottom mud. In warm weather, observation of any shallow, muddy-bottomed pond will show bubbles of the gas rising spontaneously from the mud and bursting as they reach the surface. If the bottom mud is stirred with a paddle or a stick, the gas will be evolved in greater amount. Its unpleasant, garlic-like odor is pronounced; bubbles caught at the surface can be ignited explosively with a lighted match and will emit a bluish-yellow flame.

Careful microscopic examination was made of the cuttings from the Winthrop well, and in no instance could any material of undoubted organic origin be found. The conclusion would follow that either the source of the gas had suffered complete disintegration, which would be exceedingly unlikely, or the gas has migrated from elsewhere.

Possible explanation. No gasoline, fuel oil, or bottled gas tanks have been, or now are, located within seepage range of the well. There is no direct surface evidence of faulting, which might give rise to a crush zone along which the gas could have migrated from its original source. There is a very minor amount of graphite in the local limestone (now limy phyllite). There is also free calcite in the phyllite. Surface waters, acid in nature, might conceivably attack the calcite and liberate carbon dioxide, but, under the conditions of temperature and pressure that exist, methane gas could not be formed. The writers know of no near-surface methane-producing reactions that can take place between the constituent minerals of the rocks present and percolating waters.

The most plausible explanation of this pocket of methane gas is that the gas migrated along the contact plane between the two local formations or along the bedding planes of the phyllites from some near-by swamp areas, or entered the zone of the wellhole through fractures in the country rock.

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