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positrons continues for some time after the bombardment of the B has been stopped. The equations are

$$({}_5B^{10} + {}_2He^4 = {}_7N^{13} + {}_0n^1 \text{ and } {}_7N^{13} = {}_6C^{13} + {}_{+1}e^0)$$

The N^{13} isotope formed is unstable breaking down into ${}_6C^{13}$ with the emission of the positron. The stability of an atom formed by nuclear reactions depends upon its mass relative to the sum of the masses of the free particles into which it may be decomposed. If the mass of the atom formed is greater than that of the sum of the masses of free particles, it may break up into such parts and the excess mass appear as kinetic energy of these parts.

Numerous "artificial" radioactive products, as they are called, have been produced. Fermi and his co-workers have bombarded by neutrons a large number of the heavier elements and determined the half life of the radioactive elements formed. By half-life we mean the time required for one half the atoms to disintegrate.

Elements in the first part of the periodic table, the lighter elements, may be made radioactive by bombardment with various products. Consider, for example, ${}_{11}Na^{24}$. It may be formed in at least five different ways. The half life of this atom is 15 hours and the efficiency of production is such that considerable quantities may be produced. Lawrence hopes to produce in one day radioactive Na equal in β ray activity to one gm of radium.

The practical uses of nuclear chemistry are not obvious. Since ${}_{11}Na^{24}$ emits γ rays it may be used therapeutically. Perhaps in the future if we have an ulcer of the stomach we may be given a dose of common table salt made radioactive. The radioactive Na will irradiate the stomach, within a few hours be converted into harmless magnesium which element may, however, do us some good.

CAST IRON PAVING BLOCKS

Abstract

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Minnesota has enormous quantities of iron ore, a part of which is high grade and is being utilized at the present time. The remainder is low grade but of such a nature that high grade ore can be manufactured from it. There is no possibility of exhausting the total supply of iron ore within this State for many generations, and, therefore, new uses for iron have been investigated in order to increase the market for ore.

Cast iron paving blocks have been in use for several years in France, Germany, Italy, and England, and have been declared to be superior to brick, granite block, wood block, or asphalt as a surfacing material over concrete for heavily trafficked streets and high-

ways. In large quantities, the cost of manufacturing the cast iron blocks can be reduced to such a point that they can compete with other surfacing materials. Experiments are being conducted at the University of Minnesota for the purpose of determining the advantages of this type of surfacing material, special attention being given to the problem of producing a safer paved surface for automobile traffic. Under adverse conditions caused by rain, sleet, or snow, different types of existing paved surfaces show a wide range of resistance to the slipping and skidding of automobile tires. Cast iron blocks, like automobile tires, can be made with any desired type of ridges, studs, or currugations, and it is one phase of the University experiments to determine the best type of surface possible for the safety of the driver and the pedestrian.

A test section of cast iron pavement has been laid on the campus of the University, and the results of tests, surface designs, methods of manufacture and of laying will be described and illustrated with lantern slides.

PERMANENT DISPLAY CASES—A VALUABLE ADJUNCT TO COLLEGE CHEMISTRY TEACHING—*(By Title Only)*

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RAPID ELECTRO-ANALYSIS IN A BOILING CELL

FRANZ F. EXNER, PH.D.
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To be published in *Journal of Analytical Chemistry.*

LIESEGANGS RINGS IN VERY LONG TUBES

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Of the various theories which have been presented to account for the phenomenon of rhythmic banding in gels, none is more fundamental than that based on diffusion. These laws of diffusion are operative in all cases, no matter what modifying factors are also present. Fick's law of diffusion is stated as follows:

$$ds = -D\ q\ dc/dx\ dt,$$

where ds is the quantity which passes in time dt through a cylinder of cross section q under a concentration gradient dc/dx, and D is a constant. This law leads also to the equation expressing the distance to which diffusion has progressed in a given time,

$$d = k\ c\ t^{1/2}$$

The quantity c, concentration, is an important quantity in these equations, and is assumed to be constant throughout. If it changes during the course of the reaction the diffusion fails to obey the laws, and this is exactly what has been found. In simple diffusion studies this factor has been controlled, and accurate data obtained. It has not been controlled in any studies of diffusion into gels, and in which rhythmic banding was occurring. The usual conditions of experiment use a volume of diffusing liquid much smaller than the gel, so that it is progressively diluted to a final value only a fraction of the original. Obviously in such cases the numerical value of the ratio between volumes of gel and liquid determines the dilution, and therefore the deviation from the simple laws, and becomes of great importance. Since a number of investigators have shown that the existing concentration ratio determines the number, size, and spacing of the bands, it obviously has a direct bearing on the appearance of rhythmic precipitates.

This effect is a small one at first, and does not become great until diffusion has progressed some distance. Consequently, for the experimental work to demonstrate this effect, very long tubes were employed. A number of salts which produce rhythmic bands were employed, as well as a simpler case in which the progress of diffusion was followed by the discharge of color in an indicator, uncomplicated by any bands. All of the data collected at this time support the contention that the relative volumes have a direct effect on the rate. Values of volume ratios of from 4:1 to 1:1 were studied, as well as cases in which an essentially infinite volume was employed, in which no dilution occurred. Since diffusion is very slow after a short time, the reactions will not be complete for many months, and a complete experimental report will be given at that time.

PLEISTOCENE GEOLOGY OF THE SEDIMENTS IN WHICH THE MINNESOTA MAN WAS DISCOVERED

Abstract

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When Louis Agassiz first demonstrated that continental glaciers had existed in North America during the Pleistocene, it was commonly believed that only a single period of glaciation occurred. Later field studies, however, led to the conclusion that a single ice sheet could not have accomplished the work done by the ice. Multi-

ple glaciation is now generally accepted, however the nomenclature and the relative rank of the successive advances of the ice is still subject to adjustment. The following glacial and interglacial stages of the Pleistocene are in current use by most glacial geologists. (Table 1).

TABLE 1. DIVISIONS OF THE PLEISTOCENE

Stage	North America		Europe (Alps)
		(substages)	
IV Glacial	Wisconsin	Mankato Cary Tazewell Iowan	Würm
Interglacial	Saugamon		Riss-Würm
III Glacial	Illinoian		Riss
Interglacial	Yarmouth		Mindel-Riss
II Glacial	Kansan		Mindel
Interglacial	Aftonian		Günz-Mindel
I Glacial	Nebraskan		Günz

The classification of the Iowan drift is in dispute. Leverett is of the opinion that it is more closely related to the Illinoinan than to the Wisconsin whereas Kay and Leighton believe that the Iowan should be regarded as an initial substage of the Wisconsin stage. Thwaites follows this interpretation and subdivides the Wisconsin as follows:

Stage	*Substage*
Wisconsin	5. Later Mankato Late Wisconsin or fifth Wisconsin
	4. Early Mankato or Late Wisconsin Fourth Wisconsin
	3. Cary or Middle Wisconsin Third Wisconsin
	2. Tazewell or Early Wisconsin Second Wisconsin
	1. Iowan—First Wisconsin

Thwaites' 5th substage of the Wisconsin glacier correlates with Leverett's 4th substage, commonly referred to as the Des Moines lobe of the Keewatin ice sheet. Leverett, however, distinguishes a still later substage that is referred to as substage 5 in the northwestern part of Minnesota. This would be a 6th substage if added to Thwaites' classification.

The region where the skeleton of the Minnesota Man was found lies in the heavily drift covered area of the Bemis, Gary, Altamont, and Big Stone moraines of Ottertail and Becker counties in Minnesota. These moraines were built at the eastern margin of Leverett's fifth substage of the Wisconsin (Keewatin) ice sheet.

In the region of Prairie Lake the Altamont and Gary moraines have coalesced into one great system of morainic ridges formed by a long halting period of the ice lobe. The moraines extend north and south across the west central parts of Ottertail and Becker counties. Although coalescing in part with the more extensive system, the Big Stone moraine was formed when the ice front stood a short distance to the west in northwestern Ottertail county and left an undrained outwash area between it and the Altamont and Gary moraines. In this depression a marginal lake was formed while the basin area to the west, which later formed the great Lake Agassiz, was still filled with ice.

Prairie Lake, north of Pelican Rapids, is one of the remnants of the much larger body of water that occupied this inter-morainic depression during late Pleistocene time. This expanded lake was a feature of the outwash plain extensively developed in that region. It spread eastward and northward including Lakes Lida, Lizzie and others of the immediate vicinity.

At the time of its greatest development this expanded glacial lake may have discharged its excess water over what is now the continental divide between Ottertail Lake and West Leaf Lake in east central Ottertail county. A study of the topography and the distribution of the moraines in the western part of the county indicates that the regions of the valleys of the Chippewa and Pomme de Terre rivers were still covered with ice when the Big Stone moraine was being deposited. The Chippewa River valley was formed along the western margin of the Big Stone moraine. If such an interpretation is correct, the water from the Prairie Lake region could not have drained southward as readily as eastward. When the water in Prairie Lake stood 50 feet higher than the level of 1313 feet as shown on the topographic map of the U. S. Geological Survey, it could have discharged to the southeast. The drainage was southward through the channel of the present Pelican River as far south as Erhard and then southeastward along a zone of typical glacial outwash, to the present channel of the Ottertail River. From this point eastward the glacial waters followed the valley of the Ottertail River as far east as Ottertail Lake, and there spilled over the present continental divide into the Leaf River which is a headwater tributary of the Mississippi River. As the ice left the Big Stone morainic zone at Fergus Falls a westward course was established.

The lake silt covering several square miles in the region of Prairie Lake was recognized and mapped by Dr. Leverett as early as 1914. It is typical rock flour which originated in the glacier to the north and west. It spreads over the area in seasonal layers 3½ inches to 6 inches in thickness and is in every way similar to coarsely varved glacial lake deposits. At the spot where the "Minnesota Man" was discovered this lake silt shows a thickness of 13 feet. The skeleton was found in the silt 9 feet below the highest silt beds in the cut. The varves indicate that the silts were deposited below wave-base in relatively deep, quiet water. The thickness of the individual layers implies rapid accumulation and the texture of the sediment indicates that it was deposited near the ice front. The distribution of the silt shows that the lake was sufficiently deep to cover hills as much as 70 feet higher than the level of the depressions in the present topography, for the silt is present on the tops of the hills as well as in the bottoms of depressions. Many of the irregularities in the present topography are due to post-glacial erosion. However, numerous smaller basins or pits are undoubtedly ice-block holes or pits formed by the melting of masses of ice that were buried by the drift and earlier outwash. The laminations in the silt show local dips influenced by the topography of the floor of the basin and modified by differential compaction and later frost action. In several localities the varves appear to be disturbed, but in each place where a disturbance was noted it was near the surface and was due to the action of frost and roots of plants. No crushing or crumbling due to slipping or landslides was observed.

The age of the silt bed is late Pleistocene or early Recent. It is difficult to fix the time when the Pleistocene closed and the Recent began. This is especially true when one considers the existing ice caps of Greenland and Antarctica as relics from the Pleistocene. The Pleistocene changed so gradually into the Recent that any boundary line placed between the two merely represents an arbitrary division. A logical time to consider as the beginning of the Recent would be the beginning of the last great retreat. Most glacial geologists think that retreat began with the retreat of the Des Moines lobe, 25,000 to 30,000 years ago. Leverett and Sardeson estimate that the beginning of Glacial Lake Agassiz was about 18,000 years ago. The silt beds that covered the skeleton of the Minnesota Man were deposited before the beginning of Lake Agassiz. The geologic age of the deposits, therefore, may be quite definitely established; as much so as is possible in most geologic events. The time in year may be estimated as greater than 18,000 and less than 25,000 years.

Whether or not that period of time, some twenty thousand years ago, should be designated as Pleistocene or Recent, is for the most part a matter of definition of terms. However, all of the area of northwestern Minnesota and central Canada was still being glaciated when the silts that covered the Minnesota Man were being deposited. Since glaciation was still active over such a large portion of North America the terms Late Pleistocene or Late Glacial seem more appropriate than the terms Post-Glacial or Recent.

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