will determine whether it will stand on its own merits as an independent assay procedure with biological material.

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Effect of Wind-generated Waves on Migration of the Yukon River in the Yukon Flats, Alaska[1]

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Wind-generated waves influence the migration of the Yukon River in east-central Alaska. At Circle, 125 miles downstream from the Alaska-Canada boundary, the Yukon River enters the eastern end of the Yukon Flats, an alluvial basin 20–75 miles wide and nearly 200 miles long. The Flats comprise a lowland that includes the Yukon Valley and lower parts of tributary valleys. Tributaries entering from the north are Porcupine, Sheenjek, Christian, Chandalar, Hodzana, Hadweenzic, and Dall rivers. Those entering from the south are Birch and Beaver creeks. Seven miles below Stevens, the river leaves the Flats through a narrow canyon.

From Circle to Fort Yukon the course of the Yukon is N 45° W and it is complexly braided. From Fort Yukon to a point downstream from Beaver the river changes its course to S 75° W and flows in a wide main channel, from which bow-shaped sloughs branch and re-enter. Along the north bank the channel is complicated by numerous distributaries of the Chandalar and Porcupine rivers. Near Stevens the Yukon is confined to one broad watercourse that locally branches into as many as three or four smaller channels.

Throughout the Yukon Flats, the riverbanks consist of unconsolidated alluvial gravel, sand, and silt, with minor amounts of organic material. In many places these banks are perennially frozen. Where the north bank of the river is 20′–30′ above summer river level, it is characterized by a well-developed soil profile. The vegetation is more like that found on older surfaces near the margin of the Yukon Flats than like vegetation on the south bank of the river, which is lower and lacks a well-developed soil profile. South of the river islands and bars are more numerous, and abandoned channels are filling with silt deposited during floods. These facts suggest that the alluvial features to the south are more recent than those to the north, and that the south bank has grown northward by deposition as the north bank retreated by erosion.

Russell (*1*), Goodrich (*2*), and Eakin (*3*) were among the first to suggest that the Yukon is migrating northward, basing their conclusion on the fact that the current is swifter along the north bank, where the stream is eroding the older, higher ground. To account for this migration in the Yukon Flats, Goodrich (*4*) applied Ferrel's law of terrestrial rotation, in which horizontally moving bodies are deflected to the right in the Northern Hemisphere. Deflection of a west-flowing river, such as the Yukon, would force migration to the north. Goodrich (*5*) attributed the asymmetry of some of the smaller tributary valleys to the effects of geologic structure and regional tilting. If the tilting theory were applied to the Yukon in the Flats, uplift of the area south of the river might force the river northward.

Field evidence indicates that the course of the Yukon was shifted south of its present position by deposition of gravel fans in the lower valleys of the Christian, Chandalar, and Sheenjek rivers during a period when glaciers, with sources in the Brooks Range, moved down the valleys. Since the last major glacial advance, the Yukon appears to have migrated northward and, in a few places, is eroding the lower part of the gravel fan of the Chandalar River.

At present the strongest summer winds are from the southwest, as observed by the writer and by residents of Beaver, a small village on the north bank of the Yukon. These winds, blowing against the river current, produce choppy waves with a trough-to-crest height up to 3′. The waves attain their maximum height and erosive power along the north bank of the river, especially where the wind blows unobstructed across a wide expanse of water. The south bank, in contrast, is protected from waves generated by summer winds; and in winter the prevailing northeast winds and the strong southwest winds associated with cyclonic storms cannot form waves on the ice-covered river.

Frozen banks are thawed rapidly at water level and below, and at a slower rate by warm air above water level. They thus become prey to undercutting at a rate that depends on the degree of cementation of the alluvium by ice and on the rate of removal of the eroded sediment. Frozen silt, the most cohesive bank material, can be undercut farther than frozen gravel or sand or thawed material. The process is accelerated by wind-generated waves and results in the collapse of large blocks of silt, which temporarily defend the bank against further erosion by waves and current

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until they are thawed and removed. Where the banks consist of frozen sand and gravel or thawed material, they are also effectively eroded by wind-generated waves and river current.

Local residents reported erosion of a strip approximately 200′ wide along the north bank of the Yukon downstream from Beaver during a summer characterized by long periods of strong southwest winds. In June 1950, after breakup of the river ice, strong upriver winds produced waves which, together with the current, caved the frozen silt banks upstream from Beaver as much as 35′ in two days, whereas moving river ice had relatively little effect. In August 1949, a section of the bank was undercut by waves and current and slumped into the river. This block was circumscribed by a crack that extended 90′ back from the river.

Wind-generated waves erode lake margins in much the same way, although the added effects of current and rapid fluctuations in level are lacking. The shores of some of the larger lakes in the Yukon Flats are being eroded by waves. Elongation and orientation of lakes on the arctic coastal plain of Alaska (*6*) and enlargement of thaw lakes on Seward Peninsula (*7*) have been ascribed to this type of erosion.

From these observations it is concluded that waves generated in summer by strong upriver winds are an effective erosive agent on the north bank of the river and accelerate the northward migration of the Yukon River in the Yukon Flats.

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Crystalline Visnagan

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Khellin, a crystalline dimethoxymethylfurochromone obtained from the seeds (khella) of *Ammi visnaga* L. (bishop's-weed), has attracted attention because of its vasodilatory activity (*1*).

The "visnagan" fraction, which is obtained as a more ether-soluble by-product in the preparation of khellin, was described by Samaan (*2*) as a dark, oily liquid distilling at 160° at 20 mm, with decomposition. In a recent communication, Cavallito and Rockwell (*3*) reported the isolation of a glassy product from this fraction by fractional precipitation from ether with Skellysolve B (petroleum naphtha) followed by chromatography on silica. For this glassy product they reported the following analytical data: Probable formula: $C_{22}H_{26-28}O_7$; molecular weight: found 387, calcd 402–404; specific rotation, $[\alpha]_D + 30.5°$. Pharmacologically, this product was found to be about twice as active as khellin when tested on the isolated heart.

Although khellin is a useful and potent vasodilator, any product having greater potency with fewer side effects would be a valuable adjunct to the series of compounds used for the treatment of angina pectoris. A program designed to obtain pure principles from the amorphous fraction of extracts was therefore started in these laboratories.

In addition to the isolation of the above-described material, Cavallito and Rockwell described the separation of a product identified as a "crystalline impurity" possessing the following properties: mp, 133°–140°; empirical formula, $C_{15}H_{12}O_5$; molecular weight, 272.

Applying the general method of Cavallito and Rockwell, we chromatographed an extract of khella (RI-811) from which khellin and chellolglycoside had been removed and which was optically active ($[\alpha]_D +5°$). Its vasodilatory effect was about two and one half times that of khellin (Table 1). Optical activity and ultraviolet absorption characteristics were employed as a guide in selecting eluted fractions. Optical activity was read on 0.5% solutions in 95% ethyl alcohol. We thus obtained an amorphous product possessing a specific rotation of $[\alpha]_D + 16°$ and additional fractions increasing in optical activity to $[\alpha]_D + 50°$. From this preliminary separation we subsequently obtained the two crystalline compounds described below.

TABLE 1

Flow Increase on Isolated Rabbit Heart in Comparison with Khellin

Compound	Concentration	Flow		Flow increase (%)	Potency
		Control	Test		
Standard	1: 60,000	26.5	37	40	1
RI-811	1: 150,000	30.7	43	41	2.5
Standard	1: 30,000	28.5	42	48	1
RI-832	1: 240,000	25.9	40	55	8
Standard	1: 30,000	29.5	42.7	44.9	1
RI-832-3	1: 240,000	27.1	37.3	37.6	8
Standard	1: 30,000	32.4	46.3	42.9	1
RI-778-3	1: 30,000	29.9	41.5	38.9	1

The eluate ($[\alpha]_D + 16°$) possessed the absorption spectrum described by Cavallito and Rockwell for their amorphous visnagan and had a strong dilating action on the isolated rabbit heart. We rechromatographed this fraction, discarded the first eluate, and obtained a central fraction which, on trituration with methyl alcohol, crystallized after prolonged standing at 4° C. The crystalline visnagan (RI-832), after repeated recrystallization from methanol, had a melting point of 86°–88° and a specific rotation of $[\alpha]_D + 12.5°$. The ultraviolet absorption spectrum