One hog was injected three times for a total of 11 trials. Six trials (55 percent) resulted in immobilization at dosages of 1.14 to 3.23 mg/lb. Two hogs (18 percent of the trials) were killed at dosages of 1.95 and 3.33 mg/lb and, in three trials (27 percent) at dosages of 0.81 to 1.09 mg/lb, the hogs were not completely immobilized. One hog was not immobilized at dosages of 0.81 and 0.97 mg/lb but was immobilized at a dosage of 1.95 mg/lb. Immobilization occurred in 3 to 6 minutes and averaged 4.1 ± 0.6 minutes for five trials.

The Sernylan ED_{50} and LD_{50} with corresponding 95 percent confidence limits for pen-reared hogs were 1.9 (3.2-1.1) and 4.3 (6.1-3.1) mg/lb, respectively. The ED_{99} with 95 percent confidence limits, for wild trapped hogs was 1.1 (1.6-0.7) mg.lb; however, because of the small sample size, the LD_{50} could not be computed. The expected effects, i.e., the ED or LD at the 1, 16, 50, and 99 percent levels are found in Table 3.

The only complication observed, other than mortality, was abortion, which occurred with one sow. A period characterized by thrashing of the feet usually precedes calmness. A sideways movement of the jaw is also a characteristic effect. The eyes are shut when the hog is immobilized, but eye reflexes are good. Defecation, urination or regurgitation did not occur except in those animals near death.

The hogs that died were necropsied and hemorrhaging was apparent. The fat in five of six hogs was pink in color and hemorrhagic and the renal pelvis was hemorrhagic in one hog. Petechiation of various parts of the heart was characteristic and blood was found in the peritoneal cavity of one hog. The spleen was enlarged in all hogs examined and was ruptured in one animal.

Discussion and Conclusion

The fairly rapid immobilization time, averaging 11 minutes was a favorable characteristic of this drug over the currently used drug, Cap-Chur-Barb. Two unfavorable characteristics are (1) the long recovery time, averaging approximately 6.8 hours, which is also a characteristic of Cap-Chur-Barb, and (2) the absence of a safety factor. The safety factor (LD/ED_{99}) was much less than one which indicates that the dose necessary to handle 99 percent of the pigs is well within the lethal range. Since mortality among trapped wild pigs must be held to a minimum, this drug is not recommended for this species. However, if used on wild hogs, the recommended dosage would be from 2.5 to 3.0 mg/lb.

TABLE 3. Expected effect, ED or LD, at 1, 16, 50 and 99 percent level.

	Expected effect			
	1	16	50	99
ED	0.08 mg/lb	0.5 mg/lb	1.9 mg/lb	32.0 mg/lb
LD	2.4 mg/lb	3.3 mg/lb	4.3 mg/lb	7.8 mg/lb

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REFLECTIONS ON THE SIGNIFICANCE OF CROSS BEDDING IN ANCIENT SANDSTONES

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Abstract

Studies of cross-bedding in a point bar deposit near Philipsburg, Pennsylvania have shown that "random" readings of cross-bedding dip direction taken at the intersection of lines in a grid coordinate system without regard to sedimentational units cannot be used to document ancient stream flow direction unequivocally.

Introduction

Recent studies of cross-bedding have polarized into two main efforts—one type such as Brett's (1965) uses scattered observations over a large area and another type such as that of Beutner, et al. (1967) is based on numerous measurements made in a very small area. Both these systems may be used to infer stream flow characteristics and to aid in the explanation of depositional history. Potter and Pettijohn (1963)) offer a summary of such studies.

Probably the best approach is to combine the two methods of cross-bedding analysis, and it is likely that the results of these studies depend upon (1) the mapping system used, and (2) the three dimensional orientation of the exposed strata. Thus, study of various exposures in some detail over a representatively large area minimizes abnormal measurements collected in confined observational networks.

Previous Work and Description of Study Area

In order to test the usefulness of cross bedding in a point bar deposit to determine ancient stream flow direction, a group from the University of Tennessee at Chattanooga restudied an exposure of sandstone, shale, and coal located in a strip mine approximately one mile east of Philipsburg, Pennsylvania. The sandstone exposed in this mine has been described by Beutner, et al. (1967) as an ancient point bar complex. Figure 1 shows the location of the strip mine and Figure 2 shows two trenches. One trench (Face A) trends approximately due north and is almost 350 feet long, and the other trench (Face B) trends N 60° W and is 1200 feet in length. These mines, or trenches, were opened in the spring of 1965, and the original height of both exposed faces was on the order of 50 to 60 feet, but subsequent slumping and the dumping of rubble from adjacent mines has rendered inaccessible all but the upper 15 to 20 feet of Face A.

The three lithologic units exposed in these trenches belong to the Kittanning formation (Allegheny group) of Pennsylvanian age (Figure 3). In ascending order, they are as follows: (1) three benches of Lower Kittanning coal with a total thickness that ranges between 4 and 5 feet, (2) a shale unit that ranges in thickness from almost zero to 15 feet, and (3) overlying the shale disconformably is a sandstone complex with a maximum vertical thickness of 45 feet.

Face A intersects Face B at about 60 degrees and they present a three dimensional view of part of a sandstone complex.

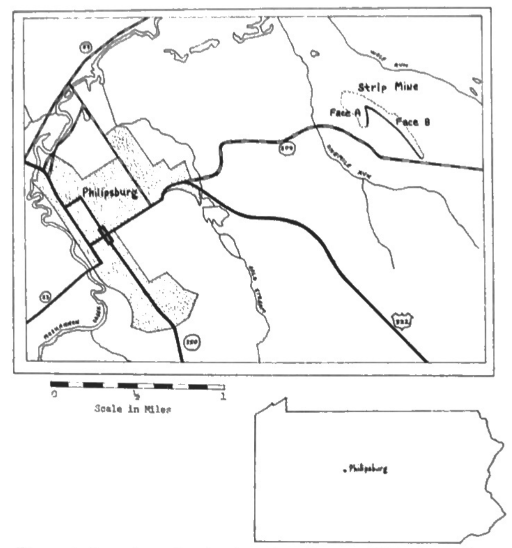

Figure 1. Location of point bar deposit near Philipsburg, Pennsylvania.

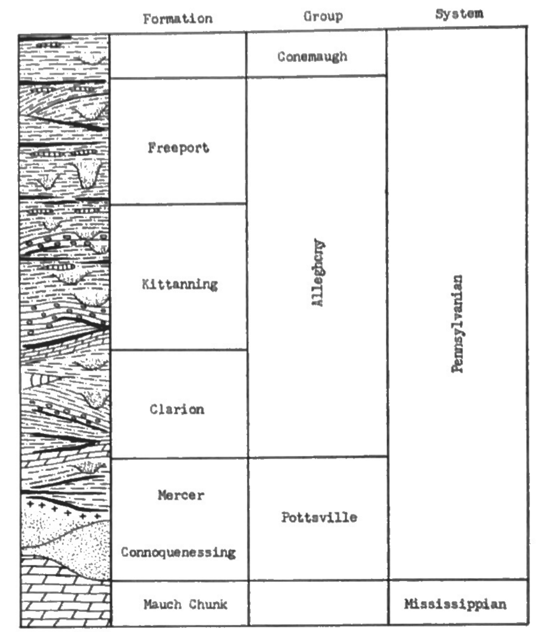

Figure 3. Generalized stratigraphic framework showing location of the Kittanning formation (Allegheny group) of Pennsylvanian Age.

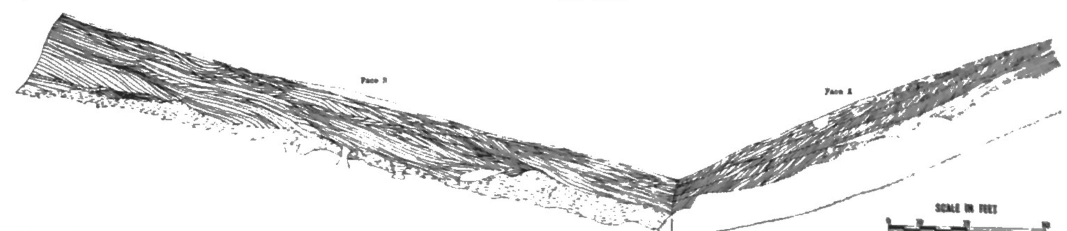

Figure 2. Three-dimensional representation of the Pennsylvanian Kittanning formation exposed near Philipsburg, Pennsylvania.

The arrangement of sedimentational units within the sandstone complex ranges widely, depending upon whether one is inspecting Face A or Face B. On Face B, certain of the sedimentational units possess a sigmoidal morphology; that is, they resemble a reclining, backward "S" (Figure 4). As observed from east to west, these units dip westward at no more than 15 degrees until they approach the sandstone-shale disconformity. Near the disconformity they curve once again and are almost parallel to the underlying units. Here the sigmoidal units thin and pinch out westwardly at the sandstone-shale contact. This pattern is repetitive throughout the sandstone complex with stratigraphically higher sedimentational units prograding far-

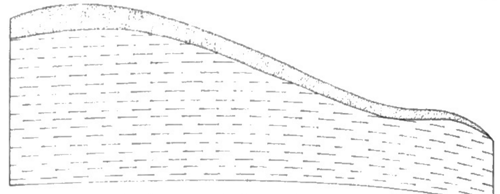

Figure 4. Profile of a sigmoidal sandstone unit overlying shale.

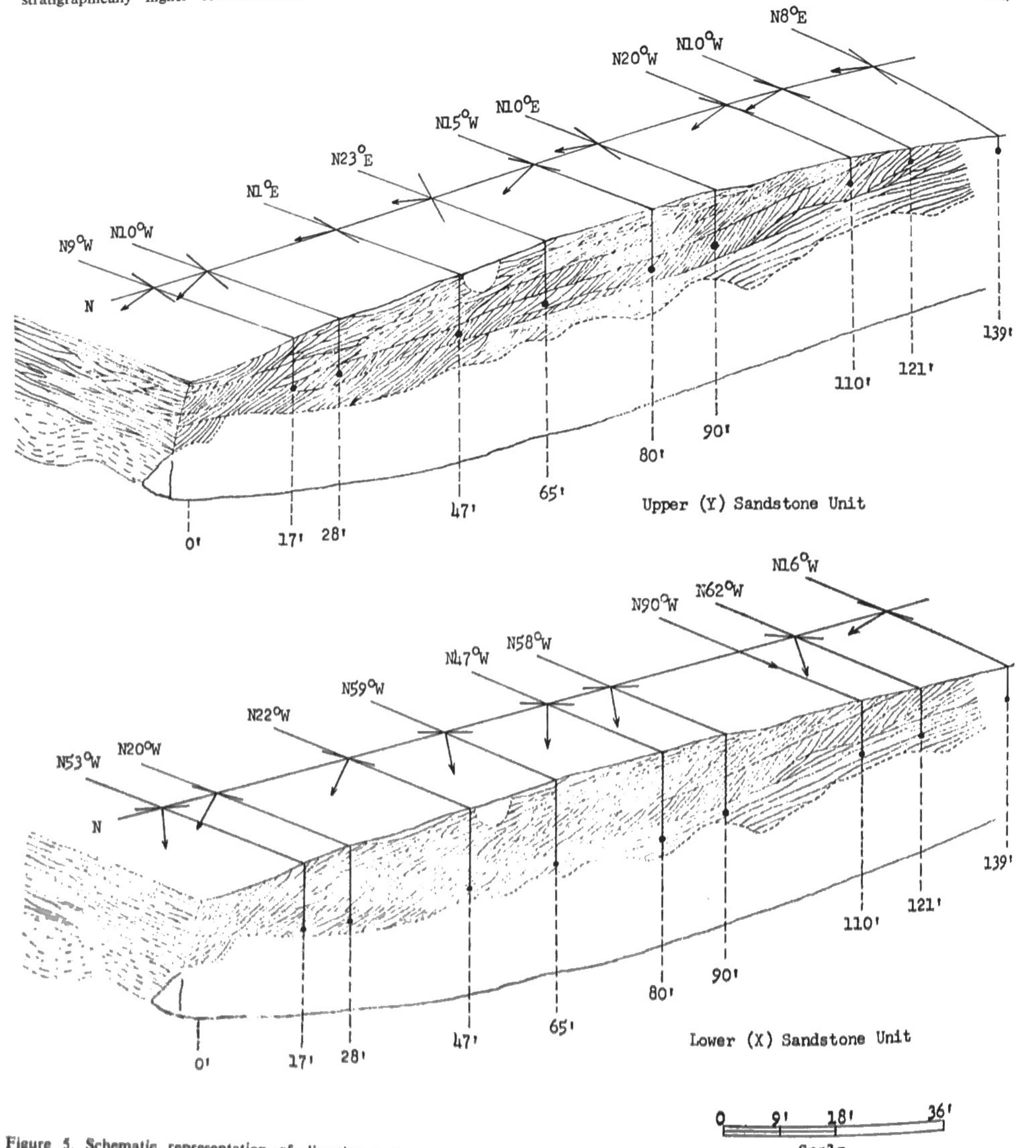

Figure 5. Schematic representation of directional dip orientation of crossbedding on Face A.

ther westward than their immediately underlying units. Allen (1965) described similar sedimentational units in the Old Red Sandstone of North Wales.

Further, the truncated sections of the sigmoidal units of Face B appear on Face A as a sequence of beds containing well-defined cross beds. Interestingly enough, a view of Face A alone does not yield any suggestion of the sigmoidal bedding found on Face B. Consequently, without an appreciation of the relationships existing between the two faces, meaningful interpretation of the three dimensional cross-bedding structures cannot be obtained.

In April of 1969, Dr. E. G. Williams of the Pennsylvania State University furnished valuable insights regarding the work of Beutner, et al. (1967), much of which was done under his supervision. However, in order to learn more about the genesis of the sandstone complex, the orientation of the cross-bedded units shown on Face A was determined (Figure 5). According to Dr. Williams, Beutner, et al. (1967), utilized a statistical approach in selecting the points at which cross-bedding orientations were measured. In essence, their measurements were taken at points determined by the intersection of lines in a grid coordinate system superimposed over the sandstone exposures without regard to sedimentational units. The readings thus obtained presumably constitute a representative, random sample of the various orientations of the internal cross-bedding. After collecting their readings, Beutner, et al., evaluated their work and determined that the dip direction of the cross-bedding ranged from essentially north-south to N 24° W and averaged N 15° W.

On the basis of their observations, Beutner et al., presented the following arguments regarding the origin of the sandstone complex:

> The sandstone body was formed almost completely by lateral accretion of bed-load sediment on the inside of a meander bend in a north-flowing stream, the shale-sandstone disconformity (scalloped contact) resulting from channel scouring by the stream as it migrated westward across the area . . . .
>
> The presence of discrete sedimentation units exposed as overlapping sigmoidal units on Face B and as tabular cross-bedded units on Face A indicates that the sand was deposited by downstream-sweeping bed forms, i.e., sand bars.
>
> The factor which controls the bedding geometry appears to be the orientation of the downstream face of the bar with respect to the current direction in the channel. If the downstream (sedimentational) edge of a transverse bar is perpendicular to flow direction, the entire edge would arrive at any transverse channel section at a given time. An individual bed deposited during this time might thus theoretically extend the full width of the unit in a transverse section (Figure 6A). On Figure 2, bedding as exposed on Face B is approximately parallel to unit boundaries and on Face A, forms tabular cross-sets between essentially horizontal unit boundaries.
>
> If the shoreward portion of the bar reached a given section before the channelward portion, deposition would occur first near the shore, and successive beds in transverse section would overlap toward the channel (Figure 6B). No complete units of channelward overlapping beds are present on Face B, but part of several units have this configuration, indicating that channelward lag of the downstream bar face may have been a transient phenomen.
>
> Similarly, if the shoreward portion of the bar lagged behind the channelward portion, depositions in a given transverse section would occur well within the channel at first, and successive beds would overlap upward and shoreward (Figue 6C). The bar form might thus tend toward a finger-like projection pointing downstream. Several units and numerous small parts of units with shoreward and upward overlapping beds are present on Face B, indicating that the bar morphology shown in Figure 6C occurred frequently but subordinately . . . .

Theoretical Discussion on Cross-Bedding

Harms and Fahnstock (1965) point out that stratification in stream environments is essentially the result of migrating bed forms, and Leopold (1964) asserts that bed forms commonly referred to as "cross-

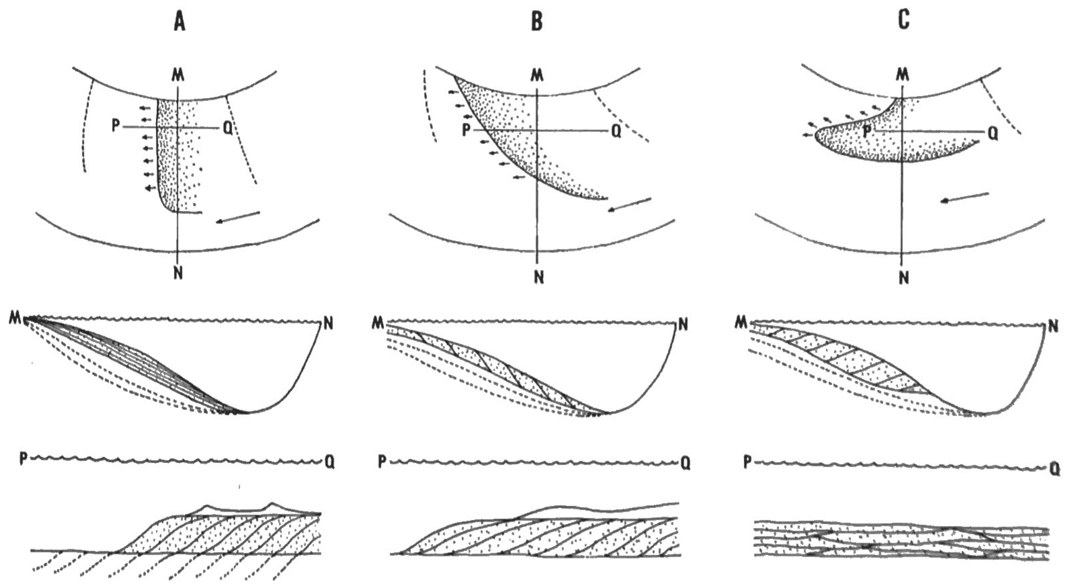

Figure 6. Idealized model illustrating the dependency of bedding geometry on bar-face orientation. Dashed lines indicate possible positions of preceding and succeeding bar faces.

bedding" are formed by dune migration under the influence of prevailing currents. Subaqueous dunes move downstream in much the same manner that terrestrial dunes are known to migrate in deserts. Localized scouring occurs on the gently sloping, upstream face of the dune while the grains disrupted by the scouring are redeposited along the steeper downstream slope, or avalanche face, of the dune. Continued supply of sediment to the avalanche face results in a forward progression of the inclined forward face of the dune.

Discontinuous supply of sediment, post-depositional erosion of partially consolidated sediment, deposition of lithologically dissimilar detritus, along with numerous other variables may produce apparent boundaries along the inclined fore-slope of the migrating dunes.

Potter and Pettijohn (1963) suggest that such features as cross-bedding may be considered as vector properties of the sedimentary deposit in which they occur.

Theoretical Discussion of Point-Bar Formation

The point bar may be defined as a sedimentary structure generated by the deposition of sediment along the convex portion of a meandering stream channel following previous erosion of the sediment from the concave portion of an "upstream" meander. The mechanics involved is not totally unlike those responsible for the formation of dunes in "straight" channels; the only difference being the introduction of more variables. As water moves through a meander bend, there is an increase in the flow velocity away from the convex section of the meander and toward the concave section of the meander. Given this increase in velocity within the concave section of the bend, the consequence is evident. Sediment along the concave bank is no longer competent to withstand the increased velocity; therefore, the bank will begin to erode more rapidly and the stream itself will approach being saturated with the additional load of sediment. The process governing the return to equilibrium will begin to function at this point. In other words, the newly acquired sediment will be redeposited in the form of dunes at the earliest convenience of the stream. The site where the sediment will be redeposited will by necessity lie within the lowest velocity regime away from the site where the sediment was eroded. Since meanders are repetitive along the course of a river, the sediment will be dropped as current velocity falls between meanders. Any point approaching and including the convex curve of the next lower meander in the channel may be considered as a potential locus for deposition.

First reflection on the formative patterns contributing to the accretion of point bars lends support to the argument proposed by Beutner, et. al. Remembering that entire channels shift laterally throughout time and that accreting point bars must necessarily exhibit the effects of this lateral shift, it seems logical to assume that exposures exhibiting successive overlapping of sigmoidal units over an apparent erosion surface are indicative of such a continuing shift. However, subsequent reflection elicits the answer to a major question. If given an introduction to a few of the possibly limitless variables capable of influencing dune orientation, and thereby cross-bedding orientation, how can it possibly be justified if one statistically manipulates or "averages" cross-bedding vectors in an effort to determine the direction of regional current flow in a channel for a long period of time, particularly in the case of an accreting point bar? Obviously, a single trench face, such as Face A, does not present enough of the point bar anatomy to determine "average" current flow.

Description of Analytical Procedure

As already mentioned, a UTC group visited a strip mine exposure near Philipsburg, Pennsylvania, in April of 1969. Unlike Beutner, et al., this group believed initially that some significance should be attached to the individuality of the cross-bedded units to be mapped. Inasmuch as each cross-bedded unit is indicative of a unique stratigraphic horizon and a unique time of origin, it was logical to assume that marked shifts in orientation of cross beds might be noted in the study of vertical stratigraphic sections (Face A). Likewise, it was reasoned that shifts in cross-bedding orientation might be revealed within a single stratigraphic horizon. To test this reasoning, it was decided to avoid the statistical approach, and to map cross bed orientations within one sedimentational unit at a time. An attempt was made to gather readings from all the major units exposed; however, extensive weathering and fracturing of the stratigraphically higher units limited selection of mappable units to two lower stratigraphic horizons.

The locations of dip orientation readings for the lowest unit, Unit X, are shown on Figure 5, and the next higher unit, Unit Y, are also shown on Figure 5. This method of mapping disclosed a variation in dip orientations within Unit X that ranged from essentially east-west to N 16° W. The range in Unit Y is from N 20° W to N 23° E. This variation in the overall pattern of dip orientation in stratigraphically different units confirmed the idea that marked shifts in dune and cross-bedding orientation do take place through time. However, it is important to note that a cyclic or any type of consistent, repetitive pattern of cross-bedding orientation could not be established in Unit X or Y. On the contrary, the readings gathered showed markedly different and rather large and apparently random shifts of cross bed orientation.

Summary and Conclusions

The random variations of cross-bedding orientation measurements confirm the expected occurrence of widely ranging values within a point bar complex. Further, the magnitude of the orientation range seems to preclude the utility of "averaging" readings in order to predict regional stream flow directions, particularly in a point bar. Granted, the individual directional values may be collected and "manipulated" to yield an "average", but the significance of this "average" is obscure. In an environment as complex as a point bar these orientational values, taken collectively, lose their significance.

The question arises as to the external geometry of the entire point bar. Only a small part of the point bar is exposed in the coal strip mines, and the size and morphology of the bar in its entirety are unknown. Beutner, et al., suggest a westwardly migrating channel and submit the westward progression of the observed sigmoidal units on Face B as evidence of such a migration. In addition, they present models (Figure 6A, 6B, 6C) suggesting possible orientations of the entire point bar within the ancient river channel. Study of their models leads to the idea that migrating point bars may assume almost any orientation within the channel. Also, their models depict point bars exhibiting various degrees of curvature in their external morphology. It is important to realize that this curvature is commonplace in the growth of a point bar; that the bar is sinuous throughout its length; and that the sinuosity of the point bar is an expression of the range of orientations of its component dunes.

The exposures studied doubtless represent random cuts through a lithified point bar. There is no way of knowing the entire dimension or morphology of the point bar from the present exposures. Nor is the orientation of the present exposures known with respect to overall form or morphology of the ancient point bar. Therefore, it is hazardous to predict regional stream flow trends on the basis of trends indicated in partial exposures, particularly on a point bar.

The proposal of Beutner, et al., that the point bar migrated westward may or may not be correct. One possible alternative is that the exposed sandstone complex may represent a portion of an ancient point bar that is oriented approximately parallel to, rather than perpendicular to, the bounding river banks. In such a case, the apparent migration could be misleading.

Acknowledgements

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THE QUALITATIVE AND QUANTITATIVE DETERMINATION OF THE ESTERS BY ALKALINE HYDROLYSIS AND GAS CHROMATOGRAPHIC ANALYSIS OF THE LIBERATED ALCOHOL

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Abstract

A procedure for the qualitative and quantitative analysis of some volatile and non-volatile esters by alkaline hydrolysis and gas chromatographic analysis of the liberated alcohol is described and evaluated. Samples of approximately 10-50 mg. in size were processed with an easily obtainable accuracy of 99 plus per cent. Conditions are described which conveniently allow complete retention of the volatile alcohols prior to and during the sample injection. Since the procedure presents no special difficulties for esters of the higher alcohols, considerable data is presented only for some methyl and ethyl esters.

Introduction

The qualitative and quantitative analysis of volatile esters by the methods of gas-liquid chromatography is standard procedure.[1,2] This procedure merely compares the response of the unknown sample and internal standard with that of a similar reference sample. However, with the increasing complexity of the samples analyzed by gas chromatography, additional quantitative gas chromatographic data other than just the response of the compound in question is most helpful, especially for samples of unknown composition.

Experimental

Apparatus: A Barber-Colman Gas Chromatograph equipped with a flame ionization detector and strip chart recorder was employed in this investigation. The column used as a 6 ft. by ¼ in. o.d. coiled glass packed with 10% Carbowax 4000 on 100/120 Anakrom ABS. Nitrogen was employed as the carrier gas. Sample injections were made with a 5 microliter Hamilton Syringe. Quantitative Procedures: An accurately measured quantity of approximately 10-25 mg of the esters was weighed into one-half ounce screw-cap bottles. A predetermined amount of n-butyl-p-aminobenzoate was