SIMPLE MEASUREMENTS OF MORPHOLOGICAL CHANGES IN RIVER CHANNELS AND HILL SLOPES

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One of the principal types of observational evidence on climatic changes in the recent geologic past is in river position and elevation. It is well known that river channels, particularly those flowing through alluvium or on relatively soft bedrock, tend to develop flood plains by lateral migration of the channel. Abandoned flood plains at elevations distinctly above the present river channel are the origin of river terraces, widespread through the world but particularly noticeable in arid regions. Climatic change is one of the causes of the abandonment of flood plains and the consequent formation of river terraces. Therefore, the identification and stratigraphy of river terraces is one of the methods by which climatic changes in the recent geologic past can be studied.

There are, of course, morphologic changes in river channels of a more subtle nature. Even when a channel is progressively degrading—a trend which will eventually result in the formation of a river terrace—there are no obvious criteria by which the current changes in a river channel can be positively identified. For this reason simple techniques, which will aid in the direct observation of current changes in a channel's position, can be helpful in identifying the nature of changes in progress.

It is the purpose of this paper to describe some relatively simple techniques which have been found to be useful in observing morphological changes on slopes and in channels. The methods have been tested primarily in arid climates but to some extent they can also be useful even where vegetation is prominent.

MONUMENTED CROSS-SECTIONS

A technique often used is the survey of a cross-section across a river channel, monumented at each end in such a manner that it can be found and resurveyed at some later date. The technique is simple enough but experience has shown that many cross-sections have been lost because of failure in the initial survey to monument and locate the end of the cross-section in a sufficiently definitive manner. The easiest and probably the best method of monumenting the end of a cross-section is to drive into the ground a steel stake which should be 3 to 4 feet in length and should be driven close to flush with the ground. The iron stakes must be relocated at some time in the future and this is where a mistake is ordinarily made. At least two additional tie points should be located and described in detail in the field notebook. The tie points may be a permanent rock, easily recognized, a nail in a tree, or some other landmark which is not likely to be destroyed in a reasonable time period. If the tie point is to be of maximum usefulness it should be in a location where a transit or plane table can be set up over it. The tie points should be so located that lines of sight from them will intersect over the iron stake at an angle not too far from 90 degrees. It has been our experience that no monument at the end of the cross-section can be relocated unless it is described by reference to independently described separate tie points where distances or angles are carefully measured. Distances are usually best. If by chance the iron stake is covered by soil creep or with sod, the intersection of the two or more lines from tie points will give an accurate location of the stake, and digging with a shovel can then be used to recover the stake.

Another important problem to be remembered in locating both the tie points and monumented ends of cross-sections is the fact that survey notes are subject to loss. The original survey notes, therefore, which describe the location of tie points and cross-sections should be photographed, or copied, when the field books are brought into the office. More than one copy should be made, and the copies must be filed and referenced in a way that if the field notebooks and one of the copies should be lost there is still another copy which could be located at some time in the future. Monumented cross-sections have been lost due to failure to observe any one or all of these simple rules—the careful description of tie points in the field, copying, and separate filing of copies of the field notes. If the tie points are well enough described, if the original monument at the end of a cross-section could not be found in the field, it could be relocated with sufficient accuracy from the descriptions, angles, or distances from tie points.

The other and probably equally important factor governing the usefulness of monumented cross-sections concerns the original location of the section itself. No one section will document sufficiently well more than one kind of change with time. If, for example, the thing to be measured is the rate of bank recession and point-bar building as the stream swings across the flood plain in time, the maximum erosion on one bank and deposition on the other can be expected in a channel bend. One cross-section in a channel bend, however, cannot be considered sufficient to give a definitive picture of the average lateral movement of a stream channel. Therefore, in attempting to measure lateral movement, cross-sections should be located in several bends and in several straight reaches in the general area.

The cross-section, of course, serves its primary usefulness in measuring aggradation or degradation with time of the channel bed itself. Consideration must therefore be given to whether the cross-section is located in a pool or on a bar in the channel. Again, several cross-sections should be established in order to represent both conditions at bars or riffles and conditions in deeps or pools in the channel.

For all these purposes the surveying should be done in such a manner that the individual points chosen for elevation determinations should represent breaks in slope so that, when connected by straight lines on the plotted profile, they would fairly represent the true conditions at the time of the survey. For such purposes the survey should ordinarily be carried out to tenths of a foot; no additional accuracy or information is provided by surveying to hundredths of a foot. It is our practice to refer all distances and elevations to the iron pin on the left bank of the channel.

PINS FOR MEASURING RATES OF BANK RECESSION

Resurvey of monumented cross-sections may not give sufficient information on the actual rates of recession of individual stream banks. In the bank for which details of bank recession rate are needed an iron pin 1 to 2 feet long is driven into the bank horizontally, usually above the level of low water but generally about half-way up the original bank. The pin is driven in so far that only one tenth of a foot remains protruding. At the time of resurvey the protrusion of the iron pin is recorded. This measurement less one-tenth of a foot is the amount of bank recession since the last observation. After the measurement is made the pin is driven with a hammer back into the bank so that again only one-tenth of a foot protrudes. The protruding end of the pin is often painted in order to make it easier to find. The location of these horizontal pins in stream banks must be recorded for later resurvey.

In banks where details of bank recession were desired we have driven such pins on 5- or 10-foot centres through a reach of 100 or 200 feet. The whole reach is then monumented and surveyed with respect to tie-points described in the case of monumented cross-sections.

An alternative is to drive such an iron pin in the stream bank on a monumented cross-section line because, once the cross-section is found, the pin can easily be located if it is still in place at the time of the next resurvey.

CHAINS AS INDICATORS OF BED SCOUR

It has long been known that the beds of channels tend to scour during high flows and to refill to a greater or lesser extent as the flood recedes. Measured cross-sections, therefore, only tell the changes which occur over relatively long periods of time and they do not indicate the amount of scour or fill that takes place in individual floods. In an attempt to get information on this factor, the following procedure has been devised which has worked well both in ephemeral streams in arid regions and in gravel streams in humid regions.

On a monumented cross-section line holes are dug in the stream channel either with a soil auger or with a shovel depending on the condition of the material in the bed and its angle of repose. The holes should be dug at least twice as deep as the estimated maximum scour which is to be expected. This is often very difficult to estimate. In ephemeral channels we usually dig the hole about 4 feet deep; in gravel streams in humid eastern United States, 1 to 3 feet has been used.

When the hole is open a piece of chain is held vertically in the hole. The lower end of the chain is usually wrapped around a flat rock, wired securely, so that the rock will act as an anchor at the lower end of the chain. The chain is held vertically in the hole until the hole is carefully refilled. When completed the chain is standing in a vertical position with the stream bed material packed carefully around it.

The purpose of this vertical chain in the stream bed is to indicate the maximum depth of scour at that point between times of observation. If the scream bed scours, a portion of the chain is exposed and the current lays the exposed portion of the chain horizontally on the stream bed. In that position it is then covered when fill occurs after the initial scour. On the resurvey, then, the location of the chain is determined by tape distances, a hole is dug carefully until the chain is reached, and the position on the chain where it changes from a vertical to a horizontal position is measured.

It will be seen that in cases of deep scour when a considerable length of chain is exposed to the flow, the anchor becomes less firm and the stress exerted on the long exposed portion of the chain becomes great. There is a tendency for the stress of the water or of debris which hangs to the chain to pull it bodily out of its position in the stream bed. More important, probably, than the rock anchored at its base is the choice of the size of the chain link. The key to the use of chains is to select a chain having a sufficiently large link that the stream bed material packs closely in the links of the chain itself. For sandy stream beds chain links having an opening of at least a half an inch are found necessary. In fine gravel the chain links should be even larger, up to perhaps one inch in diameter. A chain with a galvanized coating of zinc probably adds to the life of the installation.

With regard to placement of a series of chains on the monumented cross-section, it is our usual practice to space the chains evenly at 5- or 10-foot intervals so that, once the monuments are found, the location of the individual chains can be determined easily because of their equal spacing.

One of the techniques which involve the use of these vertical chains is the location of individual chains at equal spacing of 500 to 1,000 feet along the length of a channel. In this case a single chain is put on the centre-line of the channel at each location along the reach where measurements are desired. By plotting the data of scour and fill it can be determined whether along one portion of the reach net scour is taking place and perhaps in another reach net fill is taking place.

It should be remembered, however, that whether the chains are located individually at the centre-line of the section or several chains on a cross-section, the chains record only the maximum depth of scour at each individual point. It may be that during an individual flood one portion of the stream channel will be scoured while another portion of the same cross-section will simultaneously be filling. Then, during another part of the same flood the situation will change and the part which had previously filled will then scour. The cross-section of scour plotted from the several chains on the cross-section will indicate the maximum amount of scour but not necessarily implying simultaneity in the occurrence of that scour.

DEPTH OF FLOW

A technique has been developed by the United States Geological Survey for recording in a very simple fashion the maximum depth of water attained between individual measurements. The simple instrument is called a "crest-stage gauge". Standing vertically at the stream bank is a piece of iron pipe, perforated near the bottom and the top and capped at each end. At the base of the pipe, and resting in the bottom cap, is sprinkled some burnt cork. Standing vertically inside the pipe is a wooden stick, ordinarily marked with graduations.

When rising flood water enters the crest-stage gauge, the water in the pipe will be approximately level with the water in the channel. The burnt cork rises inside the pipe, and when the water begins to fall the cork tends to stick to the wooden rod enclosed in the pipe. This accumulation of cork indicates the highest water level attained. When the observer comes to look at the crest-stage gauge he removes the cap at the top of the vertical pipe, draws out the wooden rod, and notes the elevation of the water-mark indicated by the burnt cork.

MOVEMENT OF INDIVIDUAL ROCKS

The ability of specific flows to move rocks of various sizes can be determined by painting individual rocks and placing them on the stream bed. After an individual flow the channel is searched and all the painted rocks recovered, their positions plotted on a map and the necessary data recorded regarding their distance of travel and place of origin. In order to do this it is necessary to have each rock specifically identifiable. This has been accomplished by weighing each individual rock before it is placed on the stream bed.

It has been found that a cement-base paint lasts best under conditions of intense sunshine and of tumbling by floods in the stream channel. Bright colours are ordinarily desirable. After the rock has been painted a number is painted, in a different colour—the number being the weight of the rock in grammes. Weight expressed in three to five digits gives such a large number of combinations that no individual set of numbers is likely to be repeated.

In the experiment we are conducting in an ephemeral stream in New Mexico, the rocks painted vary in size from about 3 to 15 inches in diameter. They have been sorted by size classes. The experiment has as one objective the determination of the importance of spacing, or distance apart, of individual cobbles relative to their resistance to movement by flows of varying sizes.

One of the results of the experiment, for which four years of data are available, is that the travel distance of individual rocks during a given flow is amazingly independent of the size of the rocks. One might suppose that there would be a tendency for the small rocks to be carried farther downstream in a given flow than the large ones. This finding applies to cobbles and gravel occurring as a minor element in an ephemeral stream bed composed principally of sand.

One of the other particularly interesting and unexpected results of these observations is that the cobbles lying in a stream bed consisting primarily of sand and, containing only an admixture of gravel, are not uniformly distributed through the sandy alluvium. Rather there is a tendency for all the cobbles and gravel to lie at or very close to the surface. Not only is this a characteristic of the cobbles which occur naturally in the stream channel but also of those placed in the stream for the experiment.

Corroborative evidence was obtained in drilling holes for the placement of chains. Nearly all of the cobbles and boulders encountered in drilling the holes were immediately at the surface. Below that, through a section of three or four feet of sand, practically no cobbles were encountered.

The explanation of the tendency for the large rocks to appear on the surface of a sandy stream bed appears to lie in the effect of the dispersive grain stress of Bagnold.[1] The dispersive stress increases as the square of the grain diameter, and is greater on large than on small rocks. There is a tendency, therefore, for the rocks sustaining the largest amount of dispersive stress to be pushed toward the zone of zero dispersive stress, which is the surface of the stream bed.

After this was first observed in the experiment on the ephemeral streams, a check was made in gravelly streams in eastern United States, and the same tendency was found there. The largest rocks seemed to be concentrated near the stream bed surface.

ROCK MOVEMENT IN HEADWATER EPHEMERAL RILLS

In large channels the marking of individual rocks for observation of their movement requires the weighing of each individual cobble. In small, upstream rills the distance any individual rock is likely to move is considerably smaller and a more simple technique may be employed.

Starting at the mouth of an ephemeral rill, the drainage area of which may be several acres, individual rocks are picked out of the channel for painting. In a channel where the grain size varies from sand to 4-inch gravel, the rocks chosen are of a relatively uniform size between 2 to 4 inches in diameter. Once the size has been chosen in an individual rill, all rocks painted should be close to that same size.

The rocks are located at 10-foot intervals along the stream channel beginning at the chosen downstream point. After being completely coated with paint, the individual rocks are placed at uniform intervals up the thalweg of the rill.

When the initial coat of paint has dried, the rocks are numbered in a new colour, the numbering system beginning at the most downstream point, and each number represents the distance in feet upstream from the base point. Thus, the rock placed 250 feet upstream from the base line will carry the number 250. At the time of resurvey, the movements of individual rocks can be easily distinguished owing to the fact that the painted rocks will no longer be equally spaced, nor will they be in consecutive order.

The purpose of this type of observation is to determine how far individual rocks will move in storms of a given size. Further, it would be desirable to know whether rocks of a given size located in the steeper headward positions of a rill move farther or less far than those downstream in the same channel.

The technique described is so simple that it may be employed with little effort in a number of rills in a given area. In the New Mexico experiments, adjacent rills have been chosen for such study representing different amounts of topographic relief. To date, however, the painted rocks have all been of a uniform size, 3 to 4 inches in diameter. Such observations should be extended to determine the relative distance of movement of rocks of different sizes in similar rills.

PINS TO MEASURE RATES OF EROSION

The following technique is being used in the New Mexico experiment to measure the rates of erosion on hill slopes. Iron pins or nails, 6 to 8 inches long, are slipped through a large washer and driven into the ground in a vertical position until the head of the nail and the washer are flush with the ground surface. Erosion undermines the washer, which then falls down the length of the pin. The pin protrudes above the washer at a distance equal to the erosion during the intervening period.

A series of such pins are laid out in a grid system on a hillslope so that the amount of hillslope erosion between observations can actually be mapped in the form of a topographic map of erosion quantity.

Techniques to measure erosion on slopes, quite apart from the scour and fill of rills and channels, is a matter of considerable geomorphic interest. Much has been written about amounts of sheet erosion as judged by individual plants existing on pedestals or stools above the present land surface. However, there is always considerable doubt in attempting to explain why vegetation stands on pedestals. Accumulation of windblown sand and silt around and in the crown of a shrub will gradually tend to build a similar mount or pedestal. Therefore, unequivocal measurement of erosion during specific periods of time will yield data now lacking in the geomorphic literature.

It is particularly important that these kinds of measurements be obtained under various conditions of soil and topography and in various parts of the world in order to improve our general knowledge of relative rates of erosion under different conditions. Furthermore, because most experimental areas contain precipitation gauges, it may be possible by the accumulation of such data to improve our knowledge of the relation of erosion rates to rainfall characteristics.

1. R. A. Bagnold, "The flow of cohesionless grains in fluids", *Phil. Trans. Roy. Soc. Lond.*, vol. 249 (1956), p. 235-297.

FORM AND GRADIENT OF DEPOSITION BEHIND BARRIERS

It was once supposed that when a barrier was put in a stream channel, lifting the local base level, there would be a tendency for a wedge of deposition to accumulate behing this barrier and, in time, gradually to work headward. The end result might be to lift the streambed elevation at all points upstream by an amount of the same order of magnitude as the height of the barrier. Actual experience has shown that this is definitely not the case ; rather, the deposition above a barrier generally consists of a wedge thinning upstream. The deposition as a result of the barrier extends upstream a shorter distance than one might have supposed.

Surveys of the grade of deposition behind barriers in ephemeral stream channels have indicated that the deposition appears more to be related to the initial slope of the channel than to any other factor. The distance upstream that the wedge extends depends principally on the percentage of the original gradient represented by the gradient of the deposited wedge. These percentages of original gradient vary from 30 to 60 per cent under the few conditions where such measurements have been made. Here, again, much can be learned by extending these observations to other combinations of lithology, climate, and topography.

For such observations, only the simplest kind of barrier need be constructed. We have constructed small check dams out of rock or cement blocks so that the barrier stands only 2 to 3 feet above the original stream bed elevation. Even with such small check dams, much can be learned about the grade of deposition upstream and further studies should provide improved knowledge of the effect of the size of bed material, slope, and other factors.

STAKES FOR THE MEASUREMEN T OF SOIL CREEP OR MASS MOVEMENT

It has been our observation that, even in arid regions, a surprising amount of downslope soil movement occurs through soil creep. In an attempt to measure the magnitude of such mass movement, the following techniques are now in use.

A line is chosen essentially parallel to a contour on a slope where the rate of soil creep is to be measured. At 5- to 10-foot spacings along the length of this line, small iron rods or pipes are driven into the ground. The stakes should be of the order of 7 to 12 inches long and will protrude one-half to one inch. They are generally driven as nearly vertical as possible. The alignment of the stakes on the chosen measurement line should be as accurate as possible. The two ends of the line are monumented and are located in such a place that the monuments themselves are subject to no downhill motion. The ends of the lines thus may be an iron stake driven 4 to 5 feet deep and located at the crest of a spur, or might be a nail driven into the trunk of a large tree located on a spur. At least one of the monuments at the end of the cross-section line should be of such a nature that a transit can be set up directly over the monument. The transit is then oriented to the centre line of the monument at the far end of the line and the individual stakes along the line are so aligned. After each stake is driven an indelible notch is made with a file across the top of the iron stake, the file mark being as close to the line of sight of the instrument as possible.

In the resurvey the transit is again set up over the monument at one end of the line, oriented, and the downhill movement of each individual iron stake is measured from the line of sight.

It has been our practice to make such a line not more than 100 feet long because of the requirements for accuracy in the placement of the individual stakes.

Results to date have shown downhill movement averaging about 0.75 inch per year in alluvium of sandy silt standing at about 30^{o} slope.

SUMMARY

The techniques just described have been found both practical and profitable. The types of measurements described are considered to be both useful and simple. Their utility, however, will depend to a great extent on whether a sufficient variety of observational sites will gradually become available. It is hoped that other scientists will try these methods and data will be collected under the widest possible variety of conditions of climate, topography, and vegetation.

RÉSUMÉ

Expériences sur le terrain en vue de l'étude géomorphique des effets des variations climatiques (J. P. Miller et L. B. Leopold)

Les mécanismes et les vitesses des phénomènes de surface présentent un intérêt vital pour les géomorphologistes parce que la connaissance du présent facilite l'interprétation de l'histoire géomorphique. Les régions arides se prêtent particulièrement aux études sur le terrain des phénomènes d'érosion et d'alluvionnement, du fait que les modifications y sont assez rapides pour être mesurées facilement. Dans les régions de relief appréciable et de constitution rocheuse uniforme, en particulier, il est possible de délimiter les influences de conditions climatiques différentes. Pendant plusieurs années, les auteurs ont effectué des recherches sur l'érosion et le mouvement des sédiments dans des stations situées près de Santa Fé, au Nouveau-Mexique. Les vallées de cours d'eau éphémères dans cette région ont été soumises au cours des derniers millénaires à plusieurs cycles successifs d'érosion et de dépôt et l'archéologie et le carbone radio-actif permettent de connaître avec précision la chronologie de ces phénomènes.

Parmi les phénomènes qui font l'objet de cette enquête, on mentionnera notamment : *a*) l'érosion sur les pentes ; *b*) l'effet d'un relèvement du niveau de base sur de petits cours d'eau ; *c*) le transport de sédiments grossiers dans les cours d'eau, étudié en utilisant des pierres peintes ; *d*) l'érosion et l'alluvionnement dans le lit des cours d'eau. L'étude rassemble également des données climatiques et hydrologiques sur la question. Les résultats préliminaires montrent que des stations sur le terrain organisées pour recueillir des données spécifiques pendant plusieurs années permettent d'étudier, de façon très efficace et à peu de frais, de nombreux problèmes posés par la dynamique et la morphologie des cours d'eau.

DISCUSSION

F. A. VAN BAREN. Did Dr. Leopold in his earth-movement experiments take into account differences in types of soil, their physical properties and, specifically clay, mineralogical character? Differences in soil might explain the unexpected behaviour of the soils in the sites chosen for the experiment.

L. B. LEOPOLD. Indeed, the importance of soil types and local development of soil structure cannot be overlooked. Recalling that the present one is merely a progress report, it will perhaps be understood that no attempt has been made to explain how the soil factor enters. If other scientists would make similar measurements, we may accumulate enough data to be analysed for the effects of such factors.

C. VOÛTE. I would like to emphasize the importance of experiments of the type undertaken by Dr. Leopold. A few years ago a general survey was made of the Niger and Benue rivers in Nigeria in order to find ways of improving the efficiency of shipping on these rivers. One of the problems put before us was to determine how the rivers are behaving. This raises problems which cannot be answered by geologists or geographers on account of their studies only.

J. NAMIAS. Can you give us some indications of plans to correlate the very interesting data you are assembling with meteorological parameters (e.g. rainfall intensity, duration, etc.)?

L. B. LEOPOLD. In the New Mexico experiment, a network of about 10 simple rain gauges are maintained. Streamflow is measured at two recording stations in the 4-square-mile area. Flow measurement in ephemeral streams is not possible by standard methods, however, because of channel scour. The method of chains, explained in this paper, provides a measure of channel scour. Together with slopes of the water surface from high water marks, the peak discharge may be computed.

The present report is only a progress report. No quantitative correlations have yet been carried out but in some work already published we have shown how the combination of winter freezing frequency and stream-flow appears to govern the rate of river-bank erosion near Washington, D.C., on a single study reach of Watts Branch (see: M. G. Wolman, "Measurements of streambank erosion", *Trans. Amer. Geophys. Union, circa* 1958).

C. S. CHRISTIAN. I would like to support the experimental approach referred to by Dr. Leopold. Apart from wanting to know what has happened geomorphologically in the past, and why it has happened, we are also interested, in the practical sense, to know something about the present balance between the landscape and climate. There is frequently a very delicate balance between climate, landscape and land use. If climate and landscape are already balanced it is important to know this in order to understand the potentials and problems of the land surface.

With reference to the comment about studying the movement of sediments in large streams I might mention the use of radioactive isotopes as is being done for instance in the Hunter River of New South Wales in Australia.

O. M. ASHFORD. Experiments of the kind described could also be done in the laboratory where conditions could be controlled. What are the essential advantages of the field observations?

L. B. LEOPOLD. A large laboratory programme in hydraulic flumes is being carried out by the United States Geological Survey. The problem is that more attention has been paid in the past to laboratory methods owing to the complications of field conditions. The present work, preliminary as it is, is intended to bring to field conditions quantitative measurements of factors not represented in the laboratory. Also, the laboratory misses one of the most important factors in geomorphologic work—that of time. The measurement methods described here have their value in time effects, and it is our duty to scientists of the future to provide data that can be compared with conditions found by them at their time. The long-range importance of documentation has been realized by many, but few are willing to invest time and work now for the use of future scientists. I emphasize the point made in the present paper that copies of the records taken currently must be stored in several places lest one set of the data is lost. Also field ties to recognizable and ineradicable points on the ground are essential to obtain the full future value of current observations.

E. KRAUS. Dr. Leopold, have you measured the downstream dispersion of your groups of stones? Is it small compared to mean displacement?

L. B. LEOPOLD. The downstream lateral dispersion of rock groups is limited by channel width whereas the longitudinal dispersion is nearly unlimited. We have shown positions of individual rocks in the channel on maps, and so some record is available. The record is probably too crude to be acceptable for studies of rates of lateral dispersion of point sources. Also, rocks tend to move toward the inside or convex bends of channel curves so this is also a limitation. When rocks have moved around several bends in the channel during the downstream transportation of a mile, lateral position in the channel is not governed by dispersion theory, for factors other than random are overpowering.

G. B. MAXEY. What is the value to your studies of historical data, photos, surveys, and questioning of long-time residents in the immediate vicinity of the stream?

L. B. LEOPOLD. All historical information that has quantitative significance should be utilized. Surveys for railroads, highways, and early maps are often good sources. Old photographs that may be retaken from the same place show changes, but it is very difficult to make quantitative assessment of those changes from photographs. Also photography so far gives only a few years of time span for comparison. An example of the use of photographs and old records is the paper "Vegetation of southwestern watersheds during the nineteenth century" by L. B. Leopold, *Geographical Review* (*circa* 1952).

M^lle^ A. R. HIRSCH. La communication du D^r^ Leopold m'a vivement intéressée car, parmi les recherches faites au Centre de géographie appliquée de Strasbourg, nous avons été amenés à étudier de nombreux cours d'eau. Nous avons également cherché à avoir des méthodes simples. Nous employons aussi la méthode des « mires » pour étudier le déplacement des alluvions. En plus de la méthode des traceurs radio-actifs des particules fines, nous avons procédé à des repérages très précis par photographies que nous repérons à intervalles réguliers.

Pour ce qui est du recul des berges et de l'évolution des ravinements, nous employons également la méthode des photos-repères, appuyée par des levés topographiques qui peuvent nous donner des précisions de l'ordre de 50 cm.