

## Salt and Silt in Ancient Mesopotamian Agriculture

Progressive changes in soil salinity and sedimentation contributed to the breakup of past civilizations.

Thorkild Jacobsen and Robert M. Adams

Under the terms of a farsighted statute, 70 percent of the oil revenues of the Iraqi Government are set aside for a program of capital investment which is transforming many aspects of the country's predominantly agricultural economy. As compared with the subsistence agriculture which largely has characterized Iraq's rural scene in the past, new irrigation projects in formerly uninhabited deserts are pioneering a rapid increase in land and labor productivity through crop rotation, summer cultivation in addition to the traditional winter-grown cereals, and emphasis on cash crops and livestock.

But these and similar innovations often have disconcerting effects in a semiarid, subtropical zone—effects which cannot be calculated directly from the results of experiment in Europe and America. At the same time, old canal banks and thickly scattered ruins of former settlements testify to former periods of successful cultivation in most of the desert areas now being reopened. The cultural pre-eminence of the alluvial plains of central and southern Iraq through much of their recorded history provides still further evidence of the effectiveness of the traditional agricultural regime in spite of its prevailing reliance on a simple system of fallow in alternate years. Accordingly, the entire 6000-year record of irrigation agriculture in the Tigris-Euphrates flood plain furnishes an indispensable background for formulating plans for future development.

At least the beginnings of a compre-

hensive assessment of ancient agriculture recently were undertaken on behalf of the Government of Iraq Development Board. In addition to utilizing ancient textual sources from many parts of Iraq which today are widely scattered in the world's libraries and museums, this undertaking included a program of archeological field work designed to elucidate the history of irrigation and settlement of a portion of the flood plain that is watered by a Tigris tributary, the Diyala River (1). Here we cannot report all the diverse findings of the project and its many specialists, but instead will outline some aspects of the general ecological situation encountered by agriculturalists in the Mesopotamian alluvium which seem to have shaped the development of irrigation farming. And, conversely, we hope to show that various features of the natural environment in turn were decisively modified by the long-run effects of human agencies.

### Historical Role of Soil Salinization

A problem which recently has come to loom large in Iraqi reclamation planning is the problem of salinity. The semiarid climate and generally low permeability of the soils of central and southern Iraq expose the soils to dangerous accumulations of salt and exchangeable sodium, which are harmful to crops and soil texture and which can eventually force the farmer off his land.

For the most part, the salts in the allu-

vial soils are presumed to have been carried in by river and irrigation water from the sedimentary rocks of the northern mountains. In addition, smaller quantities may have been left by ancient marine transgressions or borne in by winds from the Persian Gulf. Beside the dominant calcium and magnesium cations, the irrigation water also contains some sodium. As the water evaporates and transpires it is assumed that the calcium and magnesium tend to precipitate as carbonates, leaving the sodium ions dominant in the soil solution. Unless they are washed down into the water table, the sodium ions tend to be adsorbed by colloidal clay particles, deflocculating them and leaving the resultant structureless soil almost impermeable to water. In general, high salt concentrations obstruct germination and impede the absorption of water and nutrients by plants.

Salts accumulate steadily in the water table, which has only very limited lateral movement to carry them away. Hence the ground water everywhere has become extremely saline, and this probably constitutes the immediate source of the salts in Iraq's saline soils. New waters added as excessive irrigation, rains, or floods can raise the level of the water table very considerably under the prevailing conditions of inadequate drainage. With a further capillary rise when the soil is wet, the dissolved salts and exchangeable sodium are brought into the root zone or even to the surface.

While this problem has received scientific study in Iraq only in very recent years, investigation by the Diyala Basin Archeological Project of a considerable number and variety of ancient textual sources has shown that the process of salinization has a long history. Only the modern means to combat it are new: deep drainage to lower and hold down the water table, and utilization of chemical amendments to restore soil texture. In spite of the almost proverbial fertility of Mesopotamia in antiquity, ancient control of the water table was based only on avoidance of overirrigation and on the practice of weed-fallow in alternate

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years. As was first pointed out by J. C. Russel, the later technique allows the deep-rooted *shoq* (*Proserpina stephanis*) and *agul* (*Alhagi maurorum*) to create a deep-lying dry zone against the rise of salts through capillary action. In extreme cases, longer periods of abandonment must have been a necessary, if involuntary, feature of the agricultural cycle. Through evapotranspiration and some slow draining they could eventually reduce an artificially raised water table to safe levels.

As to salinity itself, three major occurrences have been established from ancient records. The earliest of these, and the most serious one, affected southern Iraq from 2400 B.C. until at least 1700 B.C. A milder phase is attested in documents from central Iraq written between 1300 and 900 B.C. Lastly, there is archeological evidence that the Nahrwan area east of Baghdad became salty only after A.D. 1200.

The earliest of these occurrences particularly merits description, since it sheds light on the northward movement of the major centers of political power from southern into central Iraq during the early second millennium B.C. It seems to have had its roots in one of the perennial disputes between the small, independent principalities which were the principal social units of the mid-third millennium B.C. Girsu and Umma, neighboring cities along a watercourse stemming from the Euphrates, had fought for generations over a fertile border district. Under the ruler Entemenak, Girsu temporarily gained the ascendancy, but was unable to prevent Umma, situated higher up the watercourse, from breaching and obstructing the branch canals that served the border fields. After repeated, unsuccessful protests, Entemenak eventually undertook to supply water to the area by means of a canal from the Tigris; access to that river, flowing to the east of Girsu, could be assured without further campaigning against Umma to the northwest. By 1700 B.C. this canal had become large and important enough to be called simply "the Tigris," and it was supplying a large region west of Girsu that formerly had been watered only by the Euphrates. As a result, the limited irrigation supplies that could be drawn from the latter river were supplemented with copious Tigris water. A corresponding increase undoubtedly occurred in seepage, flooding, and overirrigation, creating all the conditions for a decisive rise in ground-water level.

Several parallel lines of evidence allow the ensuing salinization to be followed quantitatively:

- 1) Beginning shortly after the reign of Entemenak, the presence of patches of saline ground is directly attested in records of ancient temple surveyors. In a few cases, individual fields which at that time were recorded as salt-free can be shown in an archive from 2100 B.C. to have developed conditions of sporadic salinity during the 300 intervening years of cultivation.

- 2) Crop choice can be influenced by many factors, but the onset of salinization strongly favors the adoption of crops which are more salt-tolerant. Counts of grain impressions in excavated pottery from sites in southern Iraq of about 3500 B.C., made by H. Helbaek, suggest that at that time the proportions of wheat and barley were nearly equal. A little more than 1000 years later, in the time of Entemenak at Girsu, the less salt-tolerant wheat accounted for only one-sixth of the crop. By about 2100 B.C. wheat had slipped still further, and it accounted for less than 2 percent of the crop in the Girsu area. By 1700 B.C., the cultivation of wheat had been abandoned completely in the southern part of the alluvium.

- 3) Concurrent with the shift to barley cultivation was a serious decline in fertility which for the most part can be attributed to salinization. At about 2400 B.C. in Girsu a number of field records give an average yield of 2537 liters per hectare—highly respectable even by modern United States and Canadian standards. This figure had declined to 1460 liters per hectare by 2100 B.C., and by about 1700 B.C. the recorded yield at nearby Larsa had shrunk to an average of only 897 liters per hectare. The effects of this slow but cumulatively large decline must have been particularly devastating in the cities, where the needs of a considerable superstructure of priests, administrators, merchants, soldiers, and craftsmen had to be met with surpluses from primary agricultural production.

The southern part of the alluvial plain appears never to have recovered fully from the disastrous general decline which accompanied the salinization process. While never completely abandoned afterwards, cultural and political leadership passed permanently out of the region with the rise of Babylon in the 18th century B.C., and many of the great Sumerian cities dwindled to villages or were left in ruins. Probably there is no historical event of this magnitude for

which a single explanation is adequate, but that growing soil salinity played an important part in the breakup of Sumerian civilization seems beyond question.

## Silt and the Ancient Landscape

Like salt, the sources of the silt of which the alluvium is composed are to be found in the upper reaches of the major rivers and their tributaries. Superficially, the flatness of the alluvial terrain may seem to suggest a relatively old and static formation, one to which significant increments of silt are added only as a result of particularly severe floods. But in fact, sedimentation is a massive, continuing process. Silt deposited in canal beds must be removed in periodic cleanings to adjoining spoil banks, from which it is carried by rain and wind erosion to surrounding fields. Another increment of sediment accompanies the irrigation water into the fields themselves, adding directly to the land surface. In these ways, the available evidence from archeological soundings indicates that an average of perhaps ten meters of silt has been laid down at least near the northern end of the alluvium during the last 5000 years.

Of course, the rate of deposition is not uniform. It is most rapid along the major rivers and canals, and their broad levees slope away to interior drainage basins where accumulated runoff and difficult drainage have led to seriously leached soils and seasonal swamps. However, only the very largest of the present depressions seem to have existed as permanent barriers (while fluctuating in size) to cultivation and settlement for the six millennia since agriculture began in the northern part of the alluvium. More commonly, areas of swamp shifted from time to time. As some were gradually brought under cultivation, others formed behind newly created canal or river levees which interrupted the earlier avenues of drainage.

As the rate of sedimentation is affected by the extent of irrigation, so also were the processes of sedimentation—and their importance as an agricultural problem—closely related to the prevailing patterns of settlement, land-use, and even sociopolitical control. The character of this ecological interaction can be shown most clearly at present from archeological surveys in the lower Diyala basin, although other recent reconnaissance indicates that the same relation-

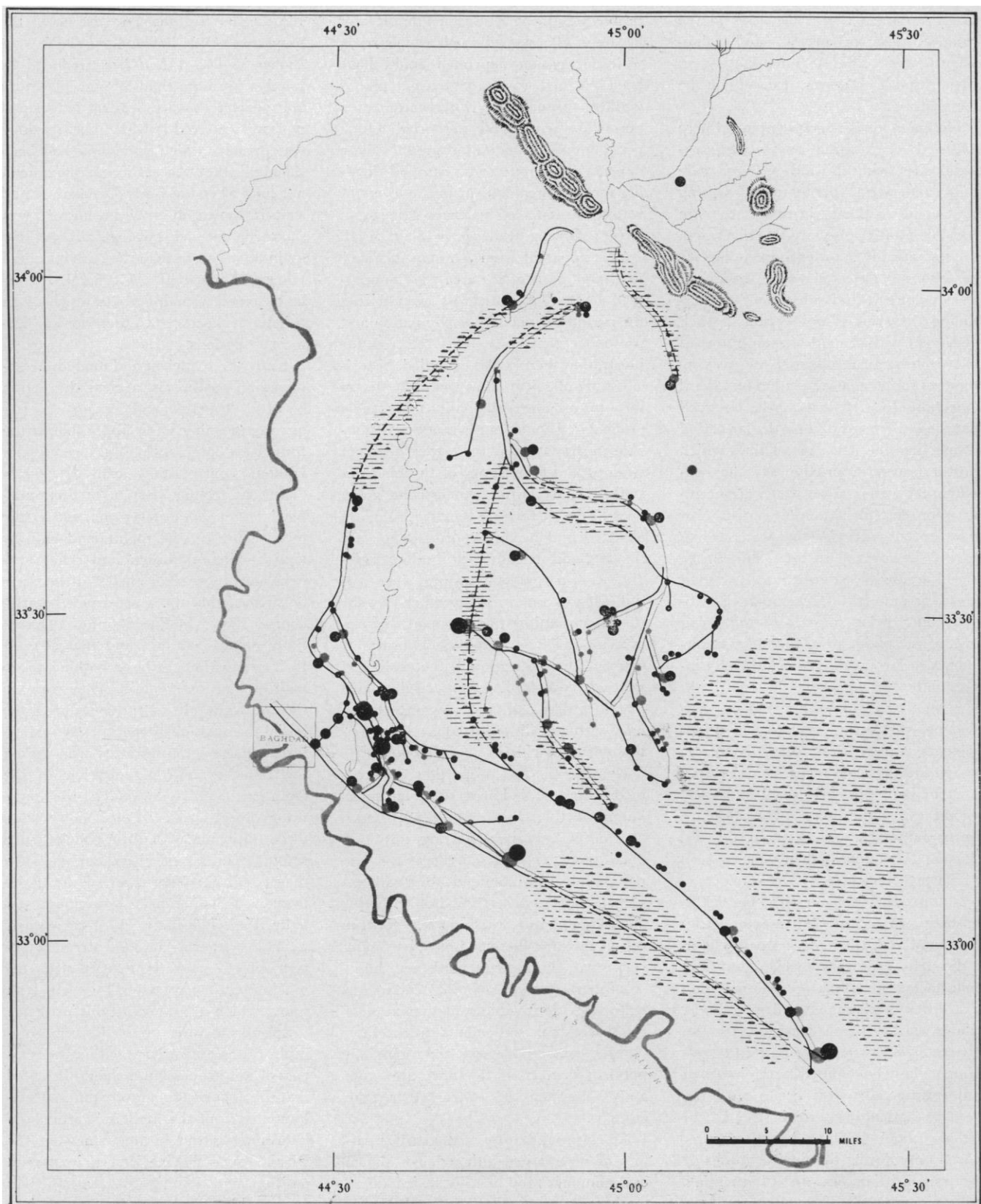


Fig. 1. Early watercourses and settlements in the Diyala region. The system shown in grey was in use during the Early Dynastic period, about 3000-2400 B.C. Sites and watercourses shown in black, slightly displaced so that the earlier pattern will remain visible, were occupied during the Old Babylonian period, about 1800-1700 B.C. In this and subsequent figures, size of circle marking an ancient settlement is roughly proportional to the area of its ruins. Modern river courses are shown in grey.

ships were fairly uniform throughout the northern, or Akkadian, part of the Mesopotamian plain (2). To what degree the same patterns occurred in the initially more urbanized (and subsequently more saline) Sumerian region further south, however, cannot yet be demonstrated.

The methods of survey employed here consisted of locating ancient occupational sites with the aid of large-scale maps and aerial photographs, visiting most or all of them—in this case, more than 900 in a 9000-square-kilometer area—systematically in order to make surface collections of selected “type fossils” of broken pottery, and subsequently determining the span of occupation at each settlement with the aid of such historical and archeological cross-ties as may be found to supplement the individual sherd collections (3). It then can be observed that the settlements of a particular period always describe networks of lines which must represent approximately the contemporary watercourses that were necessary for settled agricultural life. For more recent periods, the watercourses serving the settlements often still can be traced in detail as raised levees, spoil banks, or patterns of vegetation disturbance, but, owing in part to the rising level of the plain, all of the older watercourses so far have been located only inferentially.

A number of important and cumulative, but previously little-known, developments emerge from the surveys. By comparing the over-all pattern of settlement of both the early third and early second millennium B.C. (Fig. 1) with the prevailing pattern of about A.D. 500 (Fig. 2) these developments can be seen in sharply contrasting form. They may be summarized conveniently by distinguishing two successive phases of settlement and irrigation, each operating in a different ecological background and each facing problems of sedimentation of a different character and magnitude.

The earlier phase persisted longest. Characterized by a linear pattern of settlements largely confined to the banks of major watercourses, it began with the onset of agricultural life in the Ubaid period (about 4000 B.C.) and was replaced only during the final centuries of the pre-Christian era. In all essentials the same network of watercourses was in use throughout this long time-span, and the absence of settlement along periodically shifting side branches seems to imply an irrigation regime in which the water was not drawn great distances

inland from the main watercourses. Under these circumstances, silt accumulation would not have been the serious problem to the agriculturalist that it later became. The short branch canals upon which irrigation depended could have been cleaned easily or even replaced without the necessary intervention of a powerful, centralized authority. Quite possibly most irrigation during this phase depended simply on uncontrolled flooding through breaches cut in the levees of watercourses (like the lower Mississippi River) flowing well above plain level.

It is apparent from the map in Fig. 1 that large parts of the area were unoccupied by settled cultivators even during the periods of maximum population and prosperity that have been selected for illustration therein. An extended, historical study of soil profiles would be necessary to provide explanations for these uninhabited zones, but it is not unreasonable to suppose that some were seasonal swamps and depressions of the kind described above, while others were given over to desert because they were slightly elevated and hence not subject to easy flooding and irrigation. Still others probably were permanent swamps, since it is difficult to account in any other way for the discontinuities in settlement that appear along long stretches of some watercourses. One indication of the ecological shift which took place in succeeding millennia is that permanent swamps today have virtually disappeared from the entire northern half of the alluvium.

Considering the proportion of occupied to unoccupied area, the total population of the Diyala basin apparently was never very large during this long initial phase. Instead, a moderately dense population was confined to small regional enclaves or narrow, isolated strips along the major watercourses; for the rest of the area there can have been only very small numbers of herdsman, hunters, fishermen, and marginal catch-crop cultivators. It is significant that most of the individual settlements were small villages, and that even the dominant political centers in the area are more aptly described as towns rather than cities (4).

An essential feature of the earlier pattern of occupation, although not shown in a summary map like Fig. 1, is its fluctuating character. There is good historical evidence that devastating cycles of abandonment affected the whole alluvium. The wide and simultaneous onset of these cycles soon after relatively peaceful and prosperous times suggests

that they proceeded from sociopolitical, rather than natural, causes, but at any rate their effects can be seen clearly in the Diyala region. For example, the numerous Old Babylonian settlements shown in Fig. 1 had been reduced in number by more than 80 percent within 500 years following, leaving only small outposts scattered at wide intervals along watercourses which previously had been thickly settled. An earlier abandonment, not long after the Early Dynastic period that is shown in gray in Fig. 1, was shorter-lived and possibly affected the main towns more than the outlying small villages. Village life in general, it may be observed, remains pretty much of an enigma in the ancient Orient for all “historical” periods.

Under both ancient and modern Mesopotamian conditions, a clear distinction between “canals” and “rivers” is frequently meaningless or impossible. If the former are large and are allowed to run without control they can develop a “natural” regime in spite of their artificial origin. Some river courses, on the other hand, can be maintained only by straightening, desilting, and other artificial measures. Nevertheless, it needs to be stressed that the reconstructed watercourses shown in Fig. 2 followed essentially natural regimes and that at least their origins had little or nothing to do with human intervention. They were, in the first place, already present during the initial occupation of the area by prehistoric village agriculturalists who lacked the numbers and organization to dig them artificially. Secondly, the same watercourses persisted for more than three millennia with little change, even through periods of abandonment when they could not have received the maintenance which canals presuppose. Finally, the whole network of these early rivers describes a “braided stream” pattern which contrasts sharply with the brachiating canal systems of all later times, which are demonstrably artificial.

Specific features of the historic geography of the area are not within the compass of this article, but it should be noted that the ancient topography differed substantially from the modern. Particularly interesting is the former course of the Diyala River, flowing west of its present position and joining the Tigris River (apparently also not in its modern course) through a delta-like series of mouths. A branch that bifurcated from the former Diyala above its “delta” and flowed off for a long distance to the southeast before joining the Tigris has

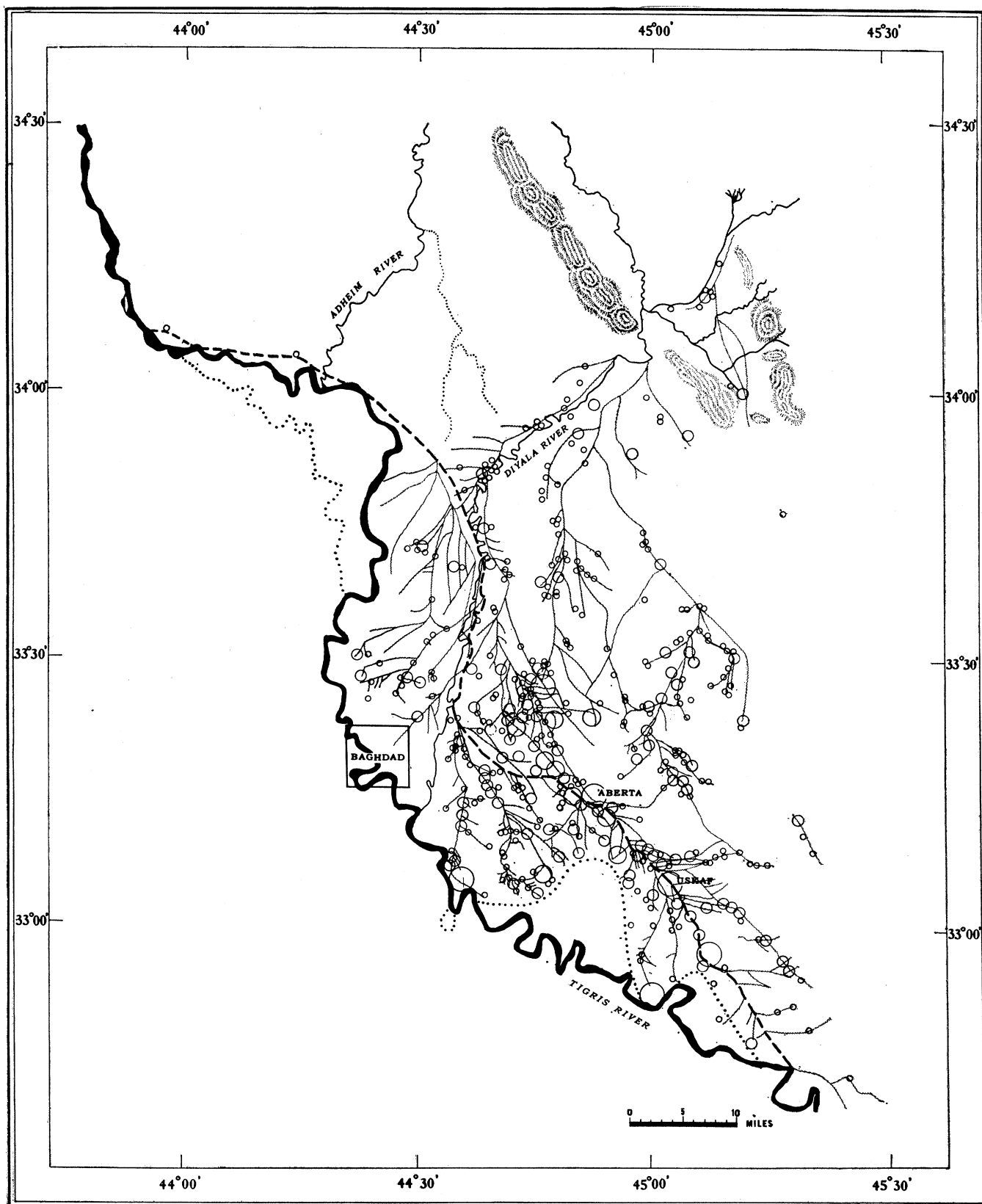


Fig. 2. Maximum extent of settlement and irrigation in the Diyala region. All canals shown by lines with minute serrations were in use during the Sassanian period, A.D. 226-637. However, expansion to the full limits came only with construction of the Nahrwan Canal (shown as a dashed black line) late in the period. Settlements shown as black circles are also of Sassanian date. The different course probably followed in places by the Tigris River during the Sassanian period is suggested by black dotted lines.

been identified tentatively as the previously unlocated "River Dabban" that is referred to in ancient cuneiform sources.

The pattern of occupation illustrated in Fig. 2 began to emerge in Achaemenian times (539–331 B.C.), after nearly 1000 years of stagnation and abandonment. Perhaps the pace of reoccupation quickened with the conquest of Mesopotamia by Alexander, but the density of population reached during much older periods was attained again, and then surpassed, only in the subsequent Parthian period (about 150 B.C.–A.D. 226). New settlements large enough to be described as true cities, on the other hand, were introduced to the area for the first time by Alexander's Macedonian followers—demonstrating, if doubt could

otherwise exist, that the onset of urbanization depends more on historical and cultural factors than on a simple increase in population density.

A central feature of this second phase of settlement is the far more complete exploitation of available land and water resources for agriculture. There is some evidence that the irrigation capacity of the Diyala River was being utilized fully even before the end of the Parthian period, and yet both the proportion of land that was cultivated and the total population rose substantially further, reaching their maxima in this area, for any period, under the Sassanian dynasty (A.D. 226–637) that followed. A rough estimate of the total agricultural production in the area first becomes possible with records of tax collections under the early

Abbasids, perhaps 300 years after the maximum limits of expansion shown in Fig. 2 had been reached. From a further calculation of the potentially cultivable land it can then be shown that (with alternate years in fallow and assuming average yields) virtually the entire cultivable area must have been cropped regularly under both the Sassanians and early Abbasids.

Increased population, the growth of urban centers, and expansion in the area of cultivation to its natural limits were linked in turn to an enlargement of the irrigation system on an unprecedented scale. It was necessary, in the first place, to crisscross formerly unused desert and depression areas with a complex—and entirely artificial—branching system of branch canals, which is outlined in Fig.

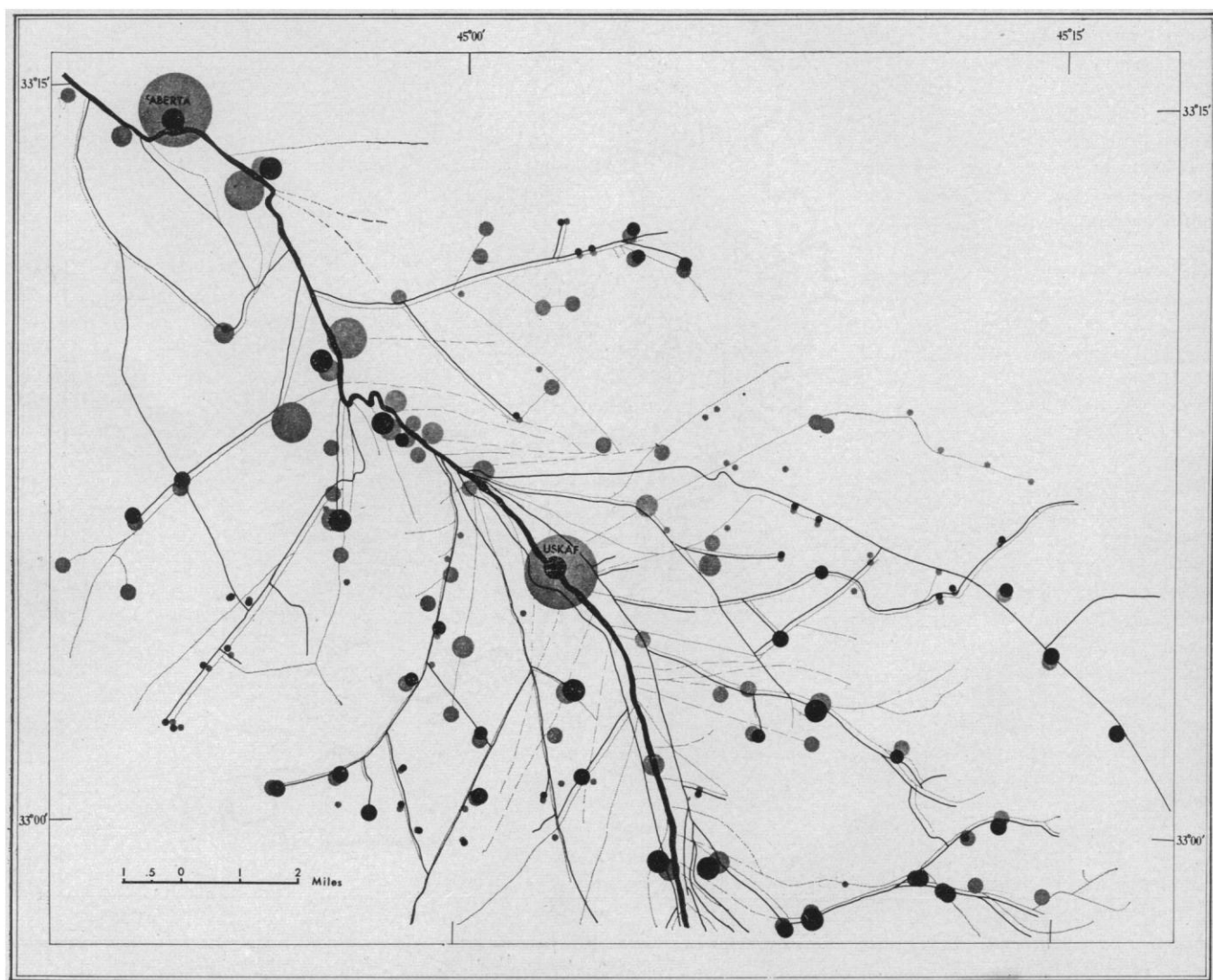


Fig. 3. Branch canal sequence along the Nahrwan. Branches shown as dashed grey lines date to the later Sassanian period (about A.D. 500–637). Settlements shown as grey circles and branch canals shown as continuous grey lines belong to the Early Islamic and Samaritan periods, prior to about A.D. 900. Settlements and branch canals shown in black are those in use during the final phase of irrigation in the lower Nahrwan district, about A.D. 1100. The weir excavated by the project was located at the junction of numerous branch canals northwest of the city of Uskaf.



2. Expansion depended also on the construction of a large, supplementary feeder canal from the Tigris which, with technical proficiency that still excites admiration, and without apparent regard for cost, brought the indispensable, additional water through a hard, conglomerate headland, across two rivers, and thence down the wide levee left by the Dabban River of antiquity. Enough survives of the Nahrwan Canal, as the lower part of this gigantic system was called, even to play a key part in modern irrigation planning. Excavations carried out by the Diyala Basin Archeological Project at one of several known weirs along the 300-kilometer course of this canal provided a forceful illustration not only of the scale of the system but also of the attention lavished on such ancillary works as thousands of brick sluice gates along its branches. In short, we are dealing here with a whole new conception of irrigation which undertook boldly to reshape the physical environment at a cost which could be met only with the full resources of a powerful and highly centralized state (5).

In spite of its unrivaled engineering competence, there were a number of undesirable consequences of the new irrigation regime. For example, to a far greater degree than had been true earlier, it utilized long branch canals which tended to fill rapidly with silt because of their small-to-moderate slope and cross-sectional area. Only the Nahrwan Canal itself—and that only during the first two centuries or so of its existence—seems to have maintained its bed without frequent and costly cleaning. Silt banks left from Parthian, Sassanian, and Islamic canal cleaning are today a major topographic feature not only in the Diyala region but all over the northern part of the Mesopotamian alluvium; frequently they run for great distances and tower over all but the highest mounds built up by ancient towns and cities. Or again, while massive control installations were essential if such a complex and interdependent system was to operate effectively, they needed periodic reconstruction at great cost (six major phases at the weir excavated by the Diyala Project) and practically continuous maintenance. Moreover, the provision of control works of all sizes acted together with the spreading networks of canal branches and subbranches to reduce or eliminate flood surges which otherwise might have contributed to the desilting process.

None of these consequences, to be sure, vitiated the advantages to be obtained

with the new type of irrigation *so long as there remained a strong central authority committed to its maintenance*. But with conditions of social unrest and a preoccupation on the part of the political authorities with military adventures and intrigues, the maintenance of the system could only fall back on local communities ill equipped to handle it. These circumstances prevailed fairly briefly in late Sassanian times, leading to a widespread but temporary abandonment of the area. After an Islamic revival, they occurred again in the 11th and 12th centuries A.D., accompanied by such storm signals of political decay as the calculated breaching of the Nahrwan during a military campaign. On this occasion there was no quick recovery; it still remains for the modern Iraqis to re-establish the prosperity for which the region once was noted.

A closer look at the role of sedimentation along the Nahrwan during the years of political crisis under the later Abbasids is given in Fig. 3. In the first illustrated phase, in late Sassanian times, irrigation water was drawn from the Nahrwan at fairly uniform intervals and applied almost directly to fields adjoining its course. During a second phase, roughly coinciding with the rise of the Abbasid caliphate, irrigation water tended to be drawn off further upstream from the field for which it was destined. This is best exemplified by the increasing importance of the weir as a source for branch canals serving a considerable area. For some distance below the weir the level of the Nahrwan apparently no longer was sufficient to furnish irrigation water above the level of the fields.

By the time of the final phase, soon after A.D. 1100, practically all irrigation in the very large region below the weir had come to depend on branch canals issuing from above it; it is worth noting that two of the largest and most important of these branches simply paralleled the Nahrwan along each bank for more than 20 kilometers. The same unsuccessful struggle to maintain irrigation control is shown by the shrinkage or disappearance of town and city life along the main canal and the depopulation of the initial 5 to 10 kilometers along each major branch issuing from it, while lower-lying communities at the distal ends of the branches continued to flourish.

This cumulative change in the character of the system probably was a consequence of both natural and social factors. On the one hand, silt deposition

had raised the level of the fields by almost 1 meter over a 500-year period. Since the natural mechanisms for maintaining equilibrium between the bed of a watercourse and its alluvial levee were largely inoperative in such a complex and carefully controlled system, this rise in land surface may have reduced considerably the level of water available for irrigation purposes. At the same time, inadequate maintenance and subsequent siltation of the Nahrwan's own bed in time sharply reduced its flow and surely also reduced the head of water it could provide to its branches. But whatever the responsible factors were, the result was an especially disastrous one. At a time when the responsibility of the central government for irrigation was eroding away and when population had been reduced substantially by warfare and by prolonged disruption of the water supply, the heavy burden of desilting branch canals remained constant or even increased for the local agriculturalist. If the accumulation of silt was no more than a minor problem at the beginning of irrigation in the Diyala basin 5000 years earlier, by the late Abbasid period it had become perhaps the greatest single obstacle that a quite different irrigation regime had to deal with.

With the converging effects of mounting maintenance requirements on the one hand, and declining capacity for more than rudimentary maintenance tasks on the other, the virtual desertion of the lower Diyala area that followed assumes in retrospect a kind of historical inevitability. By the middle of the 12th century most of the Nahrwan region already was abandoned. Only a trickle of water passed down the upper section of the main canal to supply a few dying towns in the now hostile desert. Invading Mongol horsemen under Hulagu Khan, who first must have surveyed this devastated scene a century later, have been unjustly blamed for causing it ever since.

#### References and Notes

1. The Diyala Basin Archeological Project was conducted jointly by the Oriental Institute of the University of Chicago and the Iraq Directorate General of Antiquities, on a grant from the First Technical Section of the Development Board. It was directed by one of us (T. J.), with the other (R. M. A.) and Sayyid Fuad Safar, of the Directorate General of Antiquities, as associate directors. Excavations were under the supervision of Sayyid Mohammed Ali Mustafa, also of the Directorate General of Antiquities. Field studies of paleobotanical remains were undertaken in association with the project by Dr. Hans Helbaek, of the National Museum, Copenhagen, Denmark. Intensive study of the cuneiform and Arabic textual sources on agriculture was made possible through the collaboration of scholars of many countries. Especial thanks for assist-

- ance to the field program in Iraq, and for advice in the interpretation of its results, are due to Mr. K. F. Vernon, H. E. Dr. Naji al-Asil, Dr. J. C. Russel, and Sayyid Adnan Hardan.
2. R. M. Adams, *Sumer*, in press.
  3. A preliminary application of this approximate methodology to conditions prevailing in Iraq was introduced by one of us (T. J.) in the Diyala basin in 1936-37, and the results of that earlier survey have been incorporated in the present study. Fortunately for the archeologist, there is sufficient disturbance from routine community activities (for example, foundation, well, and grave digging, and mud-brick manufacture, and so forth) for some traces of even the earli-

- est of a long sequence of occupational periods to be detected on a mound's surface.
4. Partial town plans for the political capital of the region at Tel Asmar (ancient Eshnunna) and for two other slightly smaller centers are available from extensive Oriental Institute excavations carried out in the Diyala region between 1930 and 1937. See P. Delougaz, *The Temple Oval at Khafajah* [Oriental Inst. Publ. 53 (Univ. of Chicago Press, Chicago, 1940)]; P. Delougaz and S. Lloyd, *Pre-Sargonic Temples in the Diyala Region* [Oriental Inst. Publ. 58 (Univ. of Chicago Press, Chicago, 1942)]; and H. Frankfort, *Stratified Cylinder Seals from the Diyala Region* [Oriental Inst. Publ.

- 72 (Univ. of Chicago Press, Chicago, 1955)], plates 93-96. For recent general overviews of the history and culture of the earlier periods, see A. Falkenstein "La cité-temple Sumerienne" [*Cahiers d'Histoire Mondiale* 1 (1954)] and T. Jacobsen, "Early political developments in Mesopotamia" [*Z. für Assyriologie* (N.F.) 18 (1957)].
5. General accounts of political, social, and cultural conditions in Mesopotamia during the Persian dynasties and under the Caliphate are to be found in R. Ghirshman, *Iran* (Pelican, Harmondsworth, Middlesex, England, 1954) and P. K. Hitti, *History of the Arabs* (Macmillan, London, ed. 6, 1956).

## Mr. Keynes and the "Day of Judgment"

How useful is the great economist's gloomy model  
in the light of today's thought and experience?

David McCord Wright

If consistency is the bane of little minds, Lord Keynes had certainly a great one. No one who studies the work of John Maynard Keynes can fail to be impressed by the frequent brilliance of his insights and the usefulness of many of his tools of analysis. But he lacked that sober quality which causes a man to sit down and carefully consider the consistency of his various successive theories and pronouncements. Keynes at various times approved, in writing, the essentials of a number of different restatements of his system, including one written by me (1). But when we compare the different models, thus approved, we find them to vary widely among themselves. The trouble lies in the fact that his basic model was founded on extremely narrow assumptions, and that he did not bother always to make clear to what extent he felt these assumptions applicable at a given time, and how much, in any case, he was willing to relax them (2).

Keynes' successors and disciples therefore differ widely among themselves in their interpretations. Also, it is difficult to separate one part of Keynes' analysis

from the rest. However, since selection is necessary, I have picked out for explanation and criticism that interpretation of Keynes which has, unfortunately, become most widely connected with his name.

Few aspects of Keynes' system influence modern thought more than what one of his early reviewers has called "Mr. Keynes' vision of the day of judgment"—that oft expected crisis when unregulated capitalist expansion shall be brought to an end by overinvestment or underconsumption. So deeply has this picture affected the minds of a whole generation of economists that whenever—as in the last few months—the employment index falters, it requires unusual courage and balance for an economist to resist the cry that here at last is the predicted collapse.

Yet it is not easy to dig out of Keynes' *General Theory of Employment, Interest and Money* the reasoning which underlies his frequently gloomy views (3). The book is an unusually difficult and disorderly one. In essence it consists of three separate and distinct threads of analysis which Keynes himself and many of his disciples often confuse: (i) a very precise mathematical model

based upon factual assumptions which are frequently inapplicable, (ii) a set of tautological definitions which *sound* as if they conveyed meaning but which, as one acute critic puts it, "achieve a magnificent generality by being about nothing at all," and (iii) a number of practical policy suggestions, some of which are extremely valuable and some quite the reverse. Space is lacking here to review the complicated but arid field of Keynesian terminology. What I shall do in this article is, first, to outline Keynes' basic mathematical model on which his "day of judgment" ideas are based, second, to show how limited it is, and third, to show, from a study of these limitations, wherein scientific truth requires that his conclusions and many of his policy suggestions must be seriously modified.

### How the Basic Model Works

Characteristically, Keynes deferred a statement of the basic assumptions of his fundamental model until the *eighteenth* chapter of his book, where they are often overlooked. Yet everything in his model depends upon these assumptions, and I am sure that if their limited nature were more widely recognized, Keynes' conclusion would have far less prestige. The crucial passage runs as follows:

"We take as *given* the existing skill and quantity of available labour, the existing quality and quantity of available equipment, the existing technique, the degree of competition, the tastes and habits of the consumer . . . the social structure including the forces . . . which determine the distribution of the national income. This does not mean that we assume these factors to be constant; but merely that, *in this place and context, we are not considering or taking into account* the effects and consequences of changes in them" (italics supplied) (3).

This passage (some of the more tech-

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