GEOPHYSICAL INVESTIGATIONS FOR DEVELOPMENT OF GROUNDWATER IN PARTS OF GUNTUR DISTRICT, ANDHRA PRADESH

B. SUBRAHMANYAM
G.S.I., Central Region, Nagpur
AND
T. S. RAMAKRISHNA
G.S.I., Western Region, Jaipur

ABSTRACT

Valuable information on the sub-surface geological feature was brought out in parts of Guntur District while carrying out geophysical investigations for groundwater employing seismic refraction and electrical resistivity methods during the Field Season 1967–1969. The electrical surveys were chiefly useful in demarcating more favourable zones for groundwater exploration. In the portions of thick clay cover, the seismic refraction surveys were able to delineate the Chebrole-Tangellamudi sandstone in-lier over an area of 1,200 sq. km. at depths varying from 20 to 100 metres.

A crystalline ridge which is partly controlling the groundwater flow was indicated in the middle of the basic extending over a distance of 30 km between Ponnur and Chivalur. In the present paper, the results of the surveys are discussed in the light of Oil and Natural Gas Commission (O.N.G.C.) and Exploratory Tubewell Organisation (E.T.O.) borehole data.

INTRODUCTION

THE Andhra Pradesh State Government had launched a plan to sink tubewells in the Coastal Districts of Guntur, Krishna, East and West Godavari Districts. Geophysical investigations for groundwater in parts of Guntur District were undertaken by the senior author for recommending suitable sites for tubewells (Fig. 1). The investigation was aimed at studying the sub-surface features such as the sandstones outcropping at Chebrole-Tangellamudi and to determine the thickness of sediments.

In all about 100 seismic profiles (shot-detector spread 1·2 km) and 200 electrical probes employing Wenner Configuration (maximum electrode separation 200 m) were conducted.

GEOLOGY

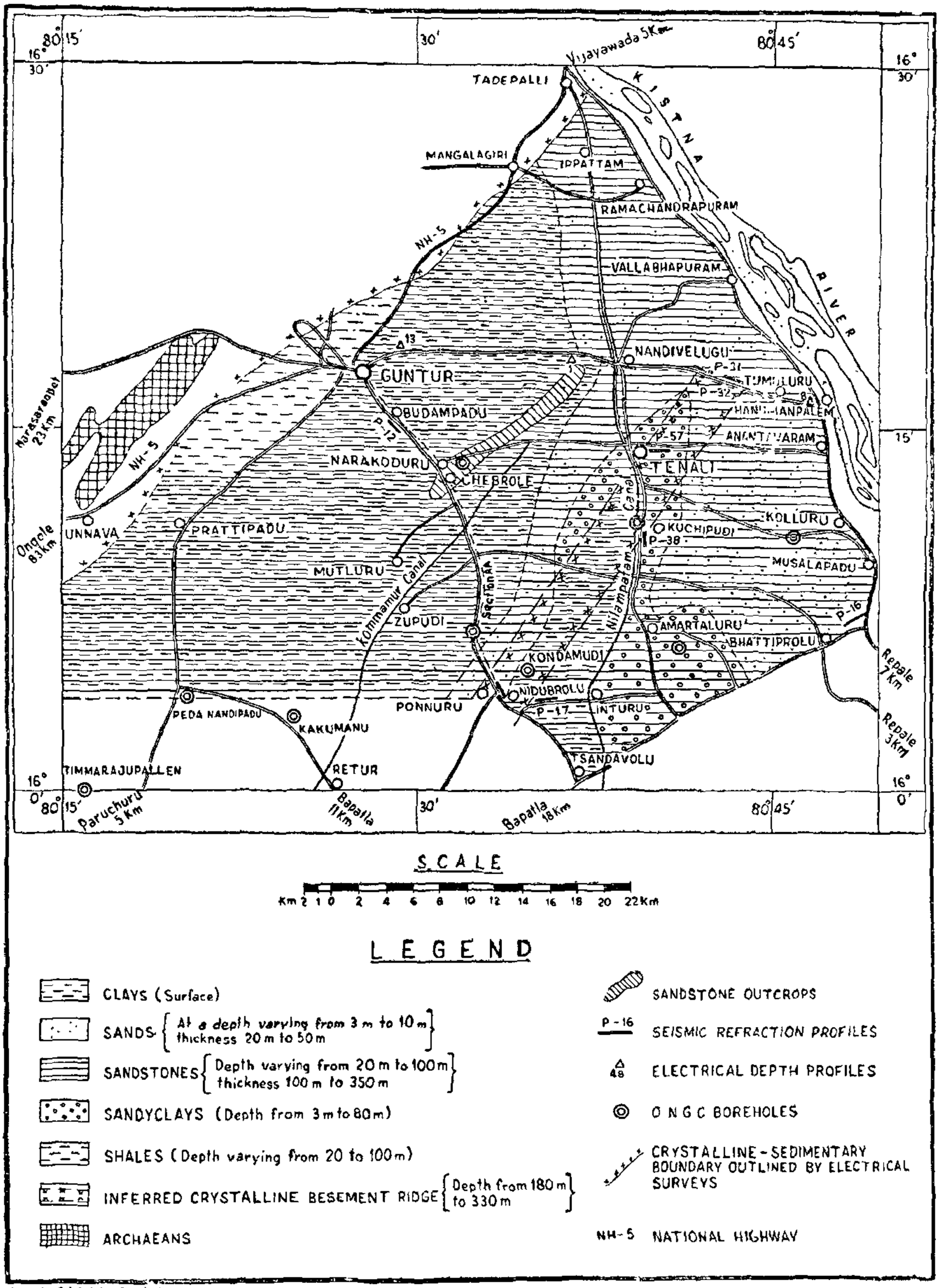
The area represents a basin possibly filled with sediments derived from the crystallines exposed west of Guntur and all along National Highway-5. The crystallines comprise of Charnockites and Khondalites. Isolated patches of sandstone (near Chebrole) and conglomerate (near Ippattam) are seen outcropping, 12 km east of the crystallines. Except these, the rest of the area is either covered by black cotton soil or alluvial deposits.

The sandstones of this area devoid of fossils are generally friable and exhibit various colours, viz., pink, red and buff. The sandstones are found to have a gentle dip towards southeast and belong to Gondwana age. According to Jacob the outcrops at Ippattam and Chebrole are lithologically same and the possibility of these beds belonging to "Tertiary" is not unlikely.

RESULTS AND DISCUSSIONS

The seismic surveys have invariably picked up the discontinuity between the unconsolidated sediments (wet zone of clay, sand, etc., 1200 to 1800 m/sec.) and the consolidated sediments in the present case sandstones, over the entire area (2000 to 2500 m/sec.). At some places velocities ranging from 3000 to 3500 m/sec. were also encountered possibly corresponding to shales or limestones (Fig. 2). It is further observed that it would not be possible to identify the sandstone belonging to different ages and they have been picked up as one layer. Comparatively lower longitudinal velocities were recorded for the sandstones in the eastern portions of the area due to the difference in compactness and composition. Crystalline basement was indicated with a longitudinal velocity of 5500 to 6000 m / sec between Ponnur and Chivalur.

Along the section AA (Fig. 3) three layers have been picked up. The top layer with a velocity of 380 to 500 m/sec. corresponds to the soil which varies in thickness from 2 to 10 m. The second layer with a velocity of 1200 to 1700 m/sec. represents the 'Wet Zone' consisting of unconsolidated clays, sands and a mixture of both and its thickness varies from 15 to 60 m. It may be worthwhile to mention that the same order of velocity is recorded for the weathered sandstone around Chebrole. The third layer with a longitudinal velocity of 2000 to 2500 m/sec. corresponds to sandstone and traced over the entire section of 22 km. An intermediate velocity of 3500 m/sec. was encountered near Budampadu at a depth of 160 m which possibly corresponds to shaly sandstones or



SCALE

Km 2 1 0 2 4 6 8 10 12 14 16 18 20 22Km

LEGEND

- CLAYS (Surface)
- SANDS { At a depth varying from 3 m to 10 m, thickness 20 m to 50 m }
- SANDSTONES { Depth varying from 20 m to 100 m, thickness 100 m to 350 m }
- SANDYCLAYS (Depth from 3 m to 80 m)
- SHALES (Depth varying from 20 to 100 m)
- INFERRED CRYSTALLINE BESEMENT RIDGE { Depth from 180 m to 330 m }
- ARCHAEANS
- SANDSTONE OUTCROPS
- P-16 SEISMIC REFRACTION PROFILES
- 48 ELECTRICAL DEPTH PROFILES
- O N G C BOREHOLES
- CRYSTALLINE-SEDIMENTARY BOUNDARY OUTLINED BY ELECTRICAL SURVEYS
- NH-5 NATIONAL HIGHWAY

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FIG. 1. Location map showing the area covered and the sub-surface geological information inferred from the geophysical surveys in parts of Guntur District, A.P.

limestones. The deposition of sandstone suggests an anticlinal flexure with its axis at Manchala. The O. N. G. C. shallow wells near Munipalle and Muchipudi have indicated the Mio-pliocene contact at a depth of 42 and 69 m respectively, and this is in agreement with the depths obtained for the top of the sandstone from the seismic refraction surveys. The sandstones outcropping at Chebrole-Tangellamudi area can thus be classified under 'Tertiary'; hitherto they have been believed to be of Gondwana age.

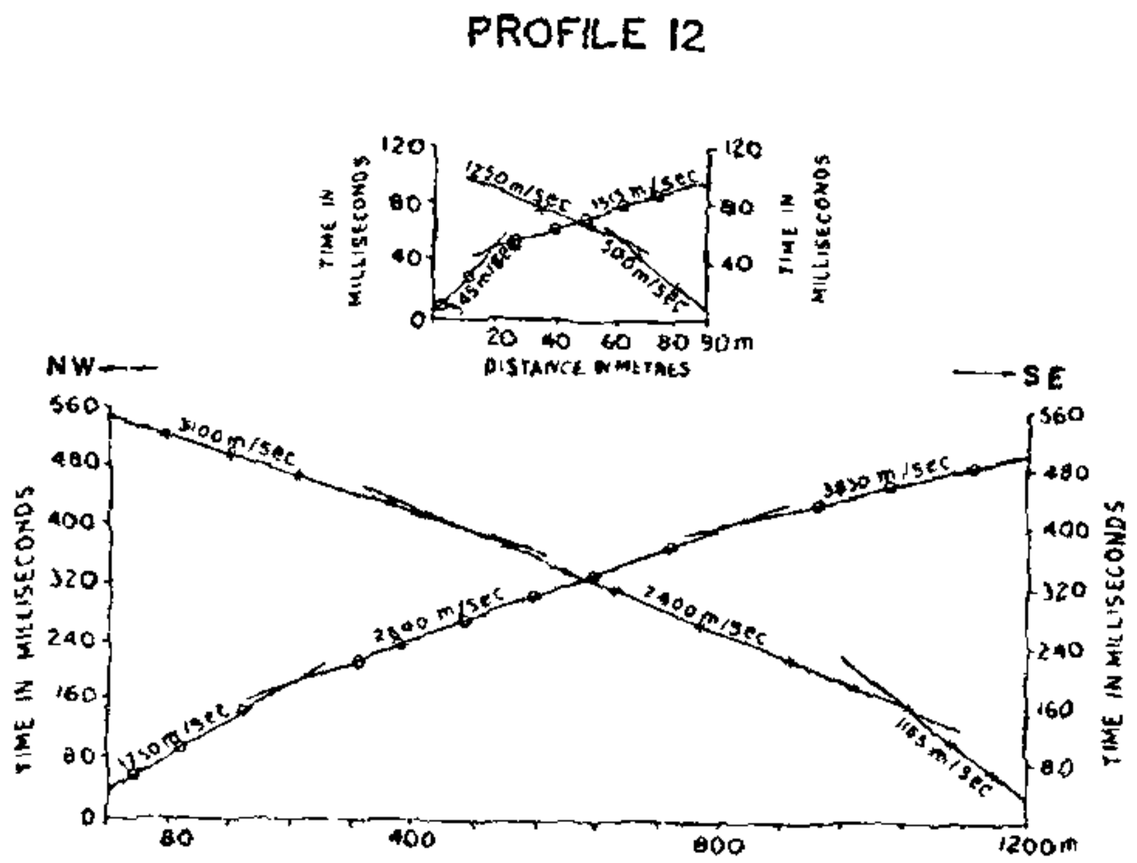

FIG. 2. Typical Time-distance curve in parts of Guntur District, A.P.

One kilometre west of Ponnur, a fourth layer with a velocity of 5250 m/sec. was indicated at a depth of 170 m. This high velocity layer represents the crystallines, occurring at relatively shallow depths in the middle of the basin. Crystalline basement was also indicated over profile P–30 to P–32, P–57 (Chadallavada), P–38 (Kuchipudi), P–51 (Poonnore) and P–17 (Nidubrolu), with depths varying from 175 to 385 m. The crystalline basement indicated in all these profiles align in a N 30° E and the absence of the high velocity layer in the near surroundings suggests a possible crystalline upliftment (Fig. 1). Sandstones (2000 to 2400 m/sec.) layer is found to be extending upto the crystalline basement.

The electrical surveys have been particularly useful in demarcating different alluvial formations, *viz.*, sands (10 to 25 ohm-metres), clays (2 to 4 ohm-metres) and clayey sand (7 to 13 ohm-metres). The depths to various interfaces are arrived from the partial matching of field curves with two layer master curves.

The probe 1 (Fig. 4) was taken over the known exposures of sandstones. This curve represents 'K' type and brought out a 55 m thick sandstone layer (50 ohm-metres) underlain by a conductive horizon (15 ohm-metres). This curve has clearly indicated the presence of claystones within the sandstones. Sandstone (2300 m/sec.) was indicated at a depth of 36 m by refraction seismic surveys at this place.

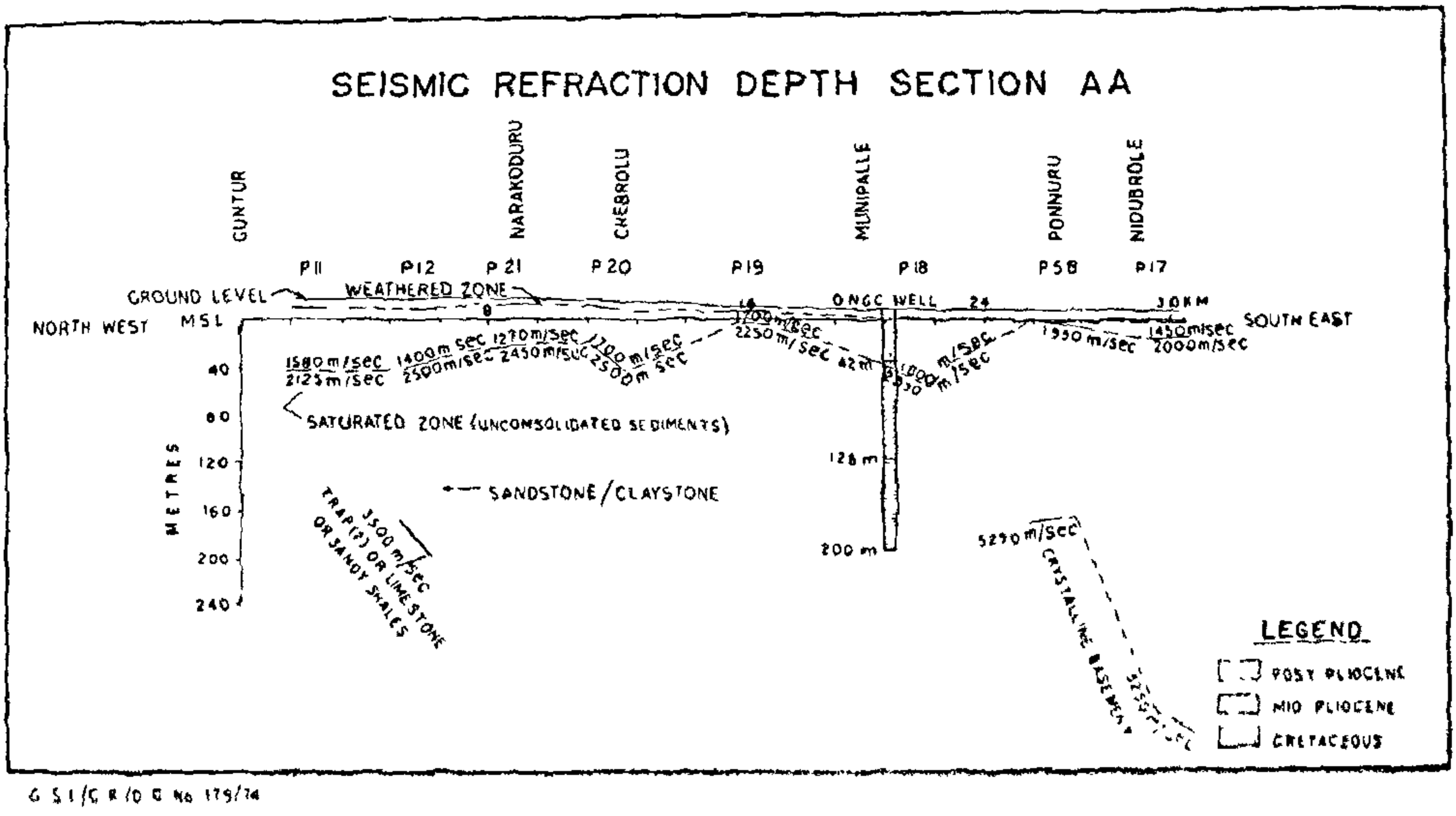

FIG. 3. Refraction seismic depth section along AA (Guntur-Nidubrolu road), Guntur District, A.P.

No high velocity layer was indicated with the short-detectors spread of 1·2 km, suggesting considerable thickness of sandstone. Drilling confirmed the presence of sandstone with clay bands upto a depth of 241 m (E.T.O. borehole Narakodur 16° 14′ 30″ : 80° 03′ 00″). The well had to be abandoned due to insufficient thickness of granular zones.

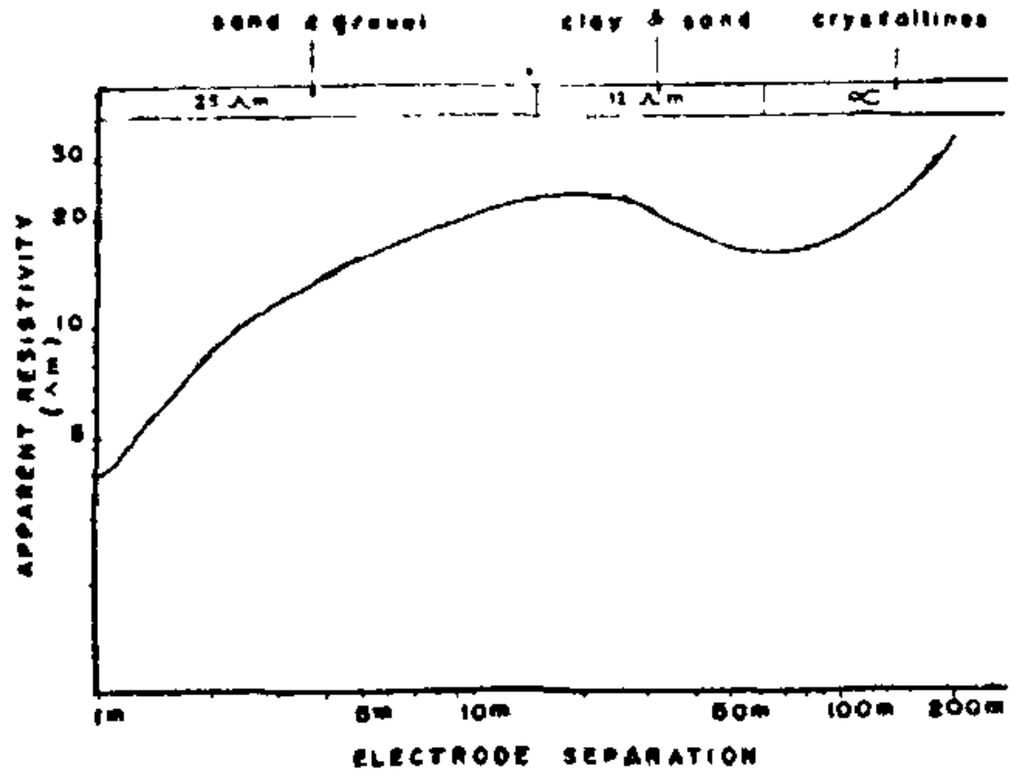

FIG. 4. Electrical depth Probe—1.

The probe 13 (Fig. 5) represents 'H' type and typical of a thick clay layer overlain by thin soil cover. The slight increase in the resistivity values at a depth of 45 m may possibly correlate to the sandstone formation, indicated at a depth of 50 m by the refraction seismic surveys.

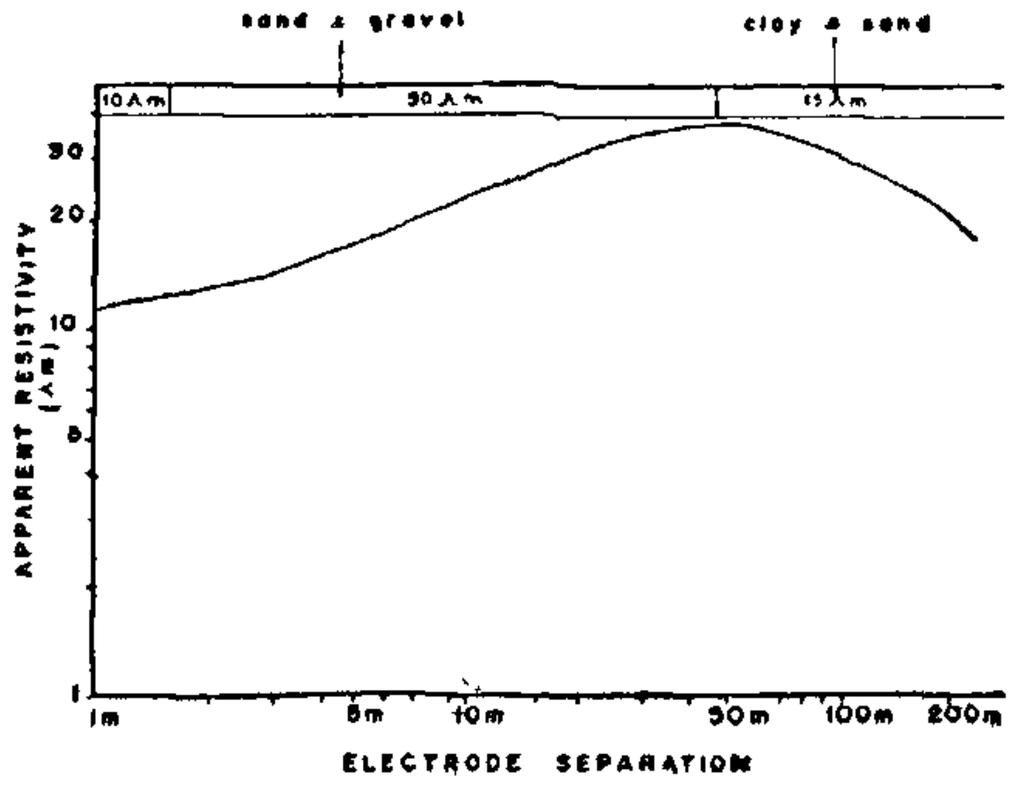

FIG. 5. Electrical depth Probe—13.

The probe 8 (Fig. 6) is selected from a prominent aquiferous zone. A two layer curve was indicated with a good thickness of resistive layer (gravel and sand—25 ohm-metres) overlain by soil cover. It is interesting to note that similar type curves were obtained between Vallabhapuram and Donepudi on the western side of river Krishna. The seismic surveys at this place have brought out a discontinuity at 30 m (1700/2000 m/sec.) which may possibly correspond to the contact between the unconsolidated/consolidated sediments. The longitudinal velocity of 2000 m/sec. is conspicuously low for sandstones obtained elsewhere in the area. On the other hand it may be mentioned that the electrical method could not distinguish between the sand and sandstones which have been picked up as one layer (25 ohm-metres) in the sounding curves. In view of the persistence of this thick resistive layer over a considerable area (Fig. 1), this zone is recommended for groundwater exploration. Later on, a test borehole put down by the E.T.O. to a depth of 306 m near Musalapadu (16° 11′ : 80° 46′) located in this zone proved to be a productive well.

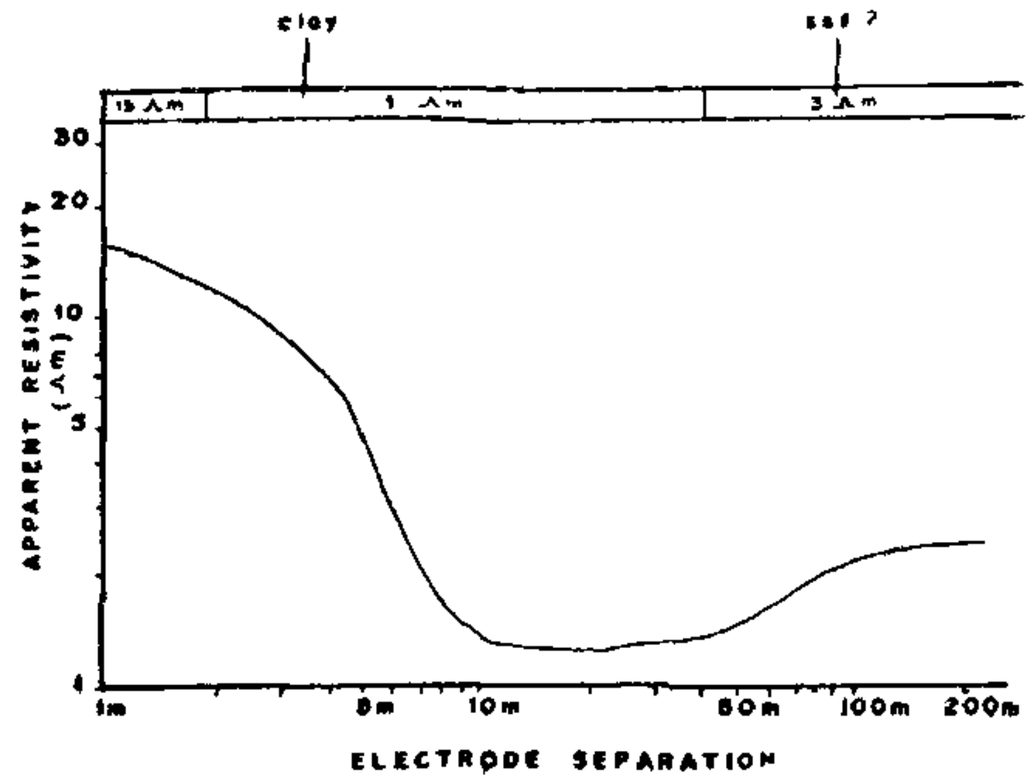

FIG. 6. Electrical depth Probe—8.

The probe 48 (Fig. 7) represents 'KH' type and has brought out two resistive layers. The first layer is attributed to sand/sandstone while the second represents crystalline.

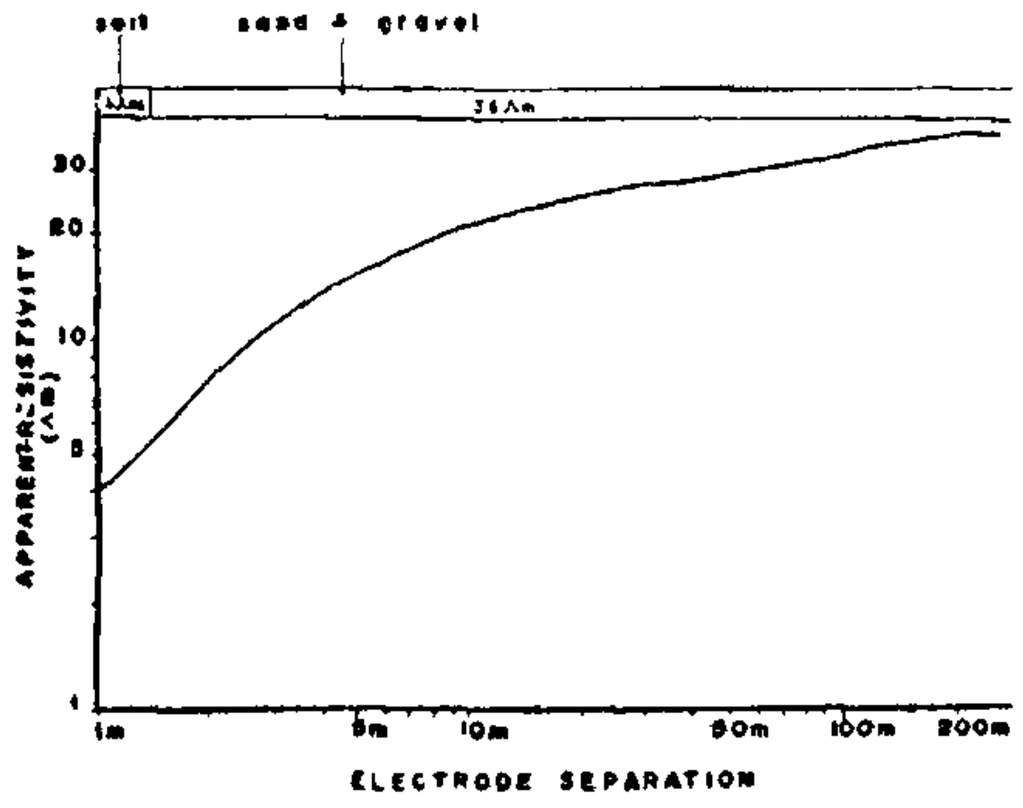

FIG. 7. Electrical depth Probe—48.

CONCLUSIONS

The sub-surface geological features inferred both from the seismic refraction and electrical resistivity

surveys are presented in Fig. 1. The surveys have indicated large thickness of sediments. Useful information on the sub-surface disposition of sand, clays, clayey sands, sandy shales, sandstones and crystallines has been clearly brought out. Three pockets of thick clay beds have been outltned around Budampadu, Panchallavaram and Penamarru by electrical surveys. E.T.O. well near Panchallavaram (16° 15′ : 80° 59′ 30″) has passed through large thickness of clays and yielded poor quality of water.

The seismic surveys have delineated sandstones (outcropping at Chebrole) with intercalations of clays over the entire area to depths varying from 20 to 100 ms. The thickness of sandstones varies from 100 to 340 m. It is further observed that sandstone peters out further south of Varagani. A crystalline basement ridge has been outlined in the NE–SW direction over a distance of 30 km between Ponnuru and Chivaluru. It is not unlikely that this ridge in the middle of the basin occurring at depths varying from 170 to 385 m controls groundwater flow in the sandstones. The E.T.O. well near Kondamudi (16° 58′ : 80° 36′) reaching depth of 305 m has intersected mostly clay bands with a few sandy layers, and has not touched the crystalline. This location of the well falls within the boundary of the inferred ridge. If the well had gone to a depth of 350 m or so, possibly the crystallines would have been struck. This well had to be abandoned due to the poor quality of water.

Recent drilling carried out by the Agro-Industries Corporation, Andhra Pradesh in the Varagani, has yielded encouraging results and confirmed the presence of sandstone layer at stipulated depths.

ACKNOWLEDGEMENT

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UPTAKE OF RADIOACTIVITY BY BODY FLUIDS AND TISSUES IN RHESUS MONKEYS AFTER INTRAVENOUS INJECTION OR INTRANASAL SPRAY OF TRITIUM-LABELLED OESTRADIOL AND PROGESTERONE

T. C. ANAND KUMAR, G. F. X. DAVID, B. UMBERKOMAN AND K. D. SAINI

Neuroendocrine Research Laboratory, Department of Anatomy, WHO-Research and Training Centre in Human Reproduction, All-India Institute of Medical Sciences, New Delhi 110016, India

THE recurrence of menstrual cycles and ovulation in non-human primates is a direct result of the neurally mediated interaction between the endocrine secretions of the adenohypophysis and the gonads[1,2]. Studies carried out recently have led to the concept that, in addition to the well-documented evidence implicating the involvement of neurons and blood, specialised ependymal derivatives and the cerebrospinal fluid (csf) constitute important cellular and humoral pathways over which the neuro-endocrine regulation of the menstrual cycle is effected[1,3,4]. The finding of sex steroids being transferred into the csf when administered intramuscularly[5] or intravenously[6] and the finding of oestrogen being able to influence gonadotropin secretion when injected into the cerebral ventricles[7] have lent additional support to this concept.

The present studies were carried out to determine whether tritium-labelled oestradiol and progesterone are transferred into the body fluids and taken up by various tissues when they are administered by intranasal spraying. A comparison of the relative uptake of the radioactivity by different tissues is made between monkeys given these steroids by intravenous injection and intranasal spray.

MATERIALS AND METHODS

Eight healthy, intact, adult female monkeys (4·5 to 6·5 kg body weight) in unknown stages of menstrual cycles were used. Four groups of two animals each were either sprayed intranasally (through the right nostril using an atomiser connected to a respiratory pump) or injected intravenously (through the right saphenous vein) with 0·1 mCi of either ^{3}H-oestradiol-17β (0·32 μg; Specific Activity: 85 Ci/mM) or ^{3}H-progesterone (0·37 μg; Specific Activity: 84 Ci/mM) dissolved in 0·2 ml of propanediol after anaesthetising the monkeys with sodium pentabarbitone (30 mg/kg body weight). The duration of injection or the