76. *Physiography of Tokyo during Late Quaternary.*

By Yanosuke OTUKA.

(Comm. by H. YABE, M.I.A., May 12, 1934.)

The city of Tokyo is divided geomorphologically into two parts, Yamanote (up-town) and Sitamati (down-town). Yamanote is situated on a terrace (the writer's Du terrace)¹⁾ 25-40 m. above sea level. Sitamati is on an alluvial plain (the writer's AII) about 1-5 m. above sea-level. This paper is mainly concerned with the underground structure of lower (down-town) Tokyo.

If a well were sunk in the middle of Marunouti, in front of the Tokyo railway station at Sitamati, we shall find the surface soil to be a few meters thick. Upon removing the thin surface soil, soft dark muds might be encountered. These soft dark greyish muds will be found to be mixed with decayed plant stems and leaves and many marine shells. These marine shells are *Ostrea gigas* Thunberg, *Arca subcrenata* Lischke, *Arca inflata* Reeve, and *Babylonia japonica* (Reeve), all of which are now living in Tokyo bay. These shells would then show that this dark greyish mud is of estuary origin. These dark greyish mud beds were called *Yurakutyo* beds by the late G. Yamakawa.²⁾ It was the first marine Alluvium named in Japan.

Still further digging would suddenly reveal subconsolidated gravel beds, Marunouti gravel beds of the writer; while the *Yurakutyo* beds shows a gradual transition in rock facies from dark greyish mud downward to silt at the base, the change from the silt to the underlying gravels is abrupt. The sand-mixed rounded pebbles composing these gravel beds show that the Marunouti beds had deposited either at a river bottom or on a beach.

Upon removing the Marunouti gravel beds, subconsolidated bluish sands, called Tokyo beds,³⁾ will then be met with. The Tokyo beds sometimes contain remains of a Lower Pleistocene mammal (*Elephas namadicus naumanni* Makiyama) and estuary shells. But if a well of the same depth were sunk at the edge of the Gohukubasi (bridge), near the eastern corner of Tokyo station, we might see the subconsolidated Tokyo beds first without either the *Yurakutyo* (mud) beds or the

1) Y. Otuka: Geogr. Rev. Japan **6** (1930); Proc. **9** (1933), 10.

2) G. Yamakawa: Jour. Geol. Soc. Tokyo, **23**, 4 (1909), (in Japanese).

3) H. Yabe: Geol. Mag., **8**, (1911).

Marunouti gravel beds. From this we know that the thickness of the Yurakutyo beds is not uniform throughout below the land surface of Lower Tokyo, but varies according to the locality. Fortunately, many boring wells were made by the Reconstruction Bureau¹⁾ and other engineering departments. Fig. 1a shows the distribution of these borings in Tokyo.

Summarising the records of these wells, we find that the thickness of the Yurakutyo beds differs at various point and that they are not distributed in the Yamanote (up-town of Tokyo). But in an elongated area in Sitamati, between Hongo to the western half of Tukisima (island) through Kanda, Nihonbasi, Ginza, there are no Yurakutyo beds, although the Yurakutyo beds thickly develop in the area from Koisikawa Edogawa valley to Sibaura through Iidabasi, Kanda-Misakityo, Marunouti, Hibiya park, and the area of the so-called Kôtô, Honzyo, and Hukagawa. Consequently if a geologic section were cut from Yamanote to Kôtô through Marunouti, we should find the profile of a valley and a hill of basal rocks, the Tokyo beds (fig. 2). Fig. 3 shows the topography of Tokyo with the Yurakutyo beds cut away. As will be seen from fig. 3, the Sitamati area is a well dissected land. In fig. 3, the depressed topographies which are supposed to be valleys continue to the actual valleys which are now seen on the land surface, e.g. the depressed topography continues from Sibaura and Honsiba to the recent Hiroo-Sibuya valley. A similar topography continues from the Siba memorial park, through Marunouti to the recent Koisikawa-Edogawa and the Tanihana valleys. The recent valley of the Sinobazu pond in Ueno park continues to Hukagawa-Susaki, through Nihonbasi-Denmatyo and Hukagawa-Mannentyo. All these depressed topographies gradually descend those bases toward south. From these facts these

1) Rep. Geol. Tokyo and Yokohama, Reconctr. Bureau (1929).

depressed topographies may be considered to be ancient river valleys that were buried by the Yurakutyo sediments. The Marunouti gravel beds are arranged along these buried valleys (fig. 2).

On the writer's Du terrace, on which the up-town of Tokyo is situated, are scattered many Neolithic shell mounds. R. Tôki¹⁾ studied the distribution of these shell mounds and on the assumption that the marine shells in these shell mounds were not transported from a remote distance, but came from a place quite near the mounds. He also concluded that most of the valleys near Tokyo were drowned by the sea during Neolithic age, and that the sea penetrated into the land valleys, at least, 50 km. from the present shoreline. It is reasonable to conclude that the sea, which deposited the Yurakutyo beds and the sea from which neolithic man collected the shells, were one and the same.

The age of formation of these valley forms in the Sitamati area of Tokyo, as shown in fig. 3, may be early Neolithic (or early Holocene age), or latest Pleistocene because the writer's Du terrace, the Upper Pleistocene terrace, is dissected by these valleys.

Summarising the foregoing, the physiographic history of Tokyo city during late Quaternary is inferred as follows:

(1) The dissection of the Du terrace and the formation of valleys, the upper course of which is seen on the recent land surface. The formation of the Marunouti gravel beds:—(Latest Pleistocene).

(2) The subsidence of land; the valleys dissecting the Du terrace

Fig. 2. Profile between I and II in fig. 3.

Fig. 3. Topographic map of Tokyo during the Latest Pleistocene. (Mainly compiled after Rep. of Reconstr. Bureau.) Contour interval 5 m. Heavy contour line represents recent mean sea-level.

1) R. Toki: Geogr. Rev. Japan, 2 (1926); Geogr. Rev. Jap., 4 (1928).

are drowned; neolithic shell mounds were built; the formation of the Yurakutyo beds:—(Early Holocene).¹⁾

(3) Decreasing or the cessation of the subsidence of land; the formation of the fluviatile plain of lower Tokyo city:—(Recent).²⁾

This is an example of early Holocene subsidence or upheaval of sea-level, which is a predominant feature on all the coasts around Japan. In this way, lower Tokyo is situated on a low, flat depositional surface of the Yurakutyo beds, which consist chiefly of soft muds resting unconformably on the dissected topography of the Tokyo beds.

Consequently the geologic structure of lower Tokyo is as if jelly had been poured into the elevated and depressed reliefs.

The difference inferred in the vibrations of the ground of Hongo (Yamanote) and Marunouti (Sitamati) from the geologic structures of these two places has been confirmed by Professor M. Ishimoto from geophysical data.³⁾

1) The alluvium, Yurakutyo beds, is one example of the "15 m. beaches" of H. Yabe; he stated "their altitude much differs from place to place and ranges usually from less than 5 m. to 20 m. in the Kwantō region". H. Yabe; Geological Growth of the Tokyo Bay. Bull. Earthq. Res. Inst., IX (1931), p. 335.

2) In this connection, H. Yabe and R. Aoki once stated: "There occurred secular shifting of strand line—first, a positive shifting of ca. 20–30 m. and then a negative one of 5–15 m. as indicated by the present coast line morphology". H. Yabe and R. Aoki: The Great Kwantō Earthquake of September 1, 1923, Geologically Considered". Saito Ho-on Kai Ann. Rep., 1926, p. 61.

3) M. Ishimoto: Bull. Earthq. Res. Inst. Tokyo Imp. Univ., **10**, 1 (1932).