Minimum and maximum magnitude threshold in the area of Attica; Greece

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SUMMARY. — The "once per year" earthquake M is a more reliable measure of seismicity than the constant a of the $N(M)$-relation. The "once per year" earthquake M is controlled by the period of observation much less than the constant a. Seismicity derived from a sample of a short period of observation inadequate at the largest magnitudes may be at least half as much smaller than that we get from a sample complete over all shocks recorded in a long period of observation. The lower bending of the straight lines representing curves of the form $\log N = a - bM$ is conditioned by the detection threshold. The maximum magnitude threshold is time dependent. Shocks associated with old, transverse deep-seated lineaments in the area of Greece are relatively greater but less frequent than those genetically connected with longitudinal structural features of the area.

RIASSUNTO. — La M relativa all'"*once per year earthquake*" è una misura di sismicità più sicura di quanto non lo sia la costante a della relazione $N(M)$. La M "*once per year earthquake*" è stata controllata per un periodo di osservazione molto più piccolo di quello usato per la costante a. La sismicità dedotta da un periodo campione di breve durata, insufficiente per le più grandi magnitudo, può essere più piccola di almeno la metà di quella ricavata da un periodo campione completo, comprendente tutte le scosse registrate durante un lungo arco di tempo. La minore inclinazione delle linee rette che rappresentano curve della forma $\log N = a - bM$, è condizionata dalla soglia di individuazione di M. La soglia in corrispondenza del massimo della magnitudo dipende dal tempo. Le scosse associate ai lineamenti trasversali, insediati in profondità nella zona della Grecia, sono relativamente più grandi, ma meno frequenti di quelle geneticamente legate ai lineamenti strutturali longitudinali della zona stessa.

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INTRODUCTION.

Earthquake sequences are well known to exhibit the relationship $\log N = a - bM$, where N is the number of earthquakes with magnitude greater than or equal to M, a and b are constant for a particular sequence.

The parameter a depends on the level of the seismic activity per unit area and unit time and varies therefore from sequence to sequence according to the size of the area involved and the period of observation (7,8).

There is evidence that the parameter b depends largely on the stress, the strength and the homogeneity of the rocks in the focal area (15,21), or the average focal depth of the earthquakes considered (6,9). The reported values of b usually lie between 0.5 and 1.5(7), but for a given geotectonic unit there is no marked change of b with the time or the number of shocks (6,14,19).

The linear relationship expressed by the foresaid equation holds for every region, small or large, but for shocks of a certain magnitude range. The number of shocks below the minimum and over the maximum magnitude threshold for a given area is less than expected from extrapolating the $\log N$ versus M curve.

The minimum as well as the maximum magnitude threshold for a given area is strongly related to the stress rate and the mechanical properties of the medium in the focal regions of the area (10). Thus, the minimum and the maximum magnitude threshold for a given area might be a seismic feature of the area.

In most regions of the Earth the return periods of major earthquakes are very long and the maximum magnitude threshold appeared in relatively short periods of observation cannot be a feature of the region. Time samples of greater than 500 to 1000 years are necessary to establish the upper limit (5).

On the contrary, the return periods of minor shocks are generally short and the minimum magnitude threshold of a given region observed in relatively short periods of observation might be a feature of the region. It is, however, to be noted, that the minimum magnitude threshold observed in a given area depends a great deal on the sensitivity of the seismographs and the number of observing stations in the area. Under these conditions it is hard to say that the minimum magnitude threshold observed in a given region is a seismic feature of the region, unless whatever increase in sensitivity of the seismographic stations does not result in lowering the level of the observed limit.

In the present paper an attempt is made to find out if the minimum magnitude threshold observed in the area of Attica is steady enough to be considered a feature of the area. The return periods of major earthquakes in the area of Attica are too long (6) to allow a reliable determination of the maximum magnitude threshold that could be another feature of the area.

REGIONAL GEOLOGICAL SETTING.

The area under investigation is located on the northwest margin of the Attic-Cycladic Massif. The age of the crystalline rock series ranges from pre-Carboniferous to Middle-Carboniferous (16), and occasionally up to Cretaceous (12). The crystalline basement is unconformably overlain by Upper Palaeozoic sedimentary rocks. The Mesozoic sediments are represented by the Triassic system and lie unconformably on the Palaeozoic sediments (11).

The northern end of the Attic-Cycladic Massif represents the metamorphic continuation of the eastern Hellenic Zone (3,13). The crystalline basement is the common hard core of all the sedimentary series of eastern Greece.

The eastern Hellenic Zone, also known as *Subpelagonic Zone*, surrounds the Attic-Cycladic Massif of the *Pelagonic Zone*. The Subpelagonic Zone, which outcrops in most of the environments, consists of metamorphosed and unmetamorphosed sedimentary and volcanic rocks ranging in age from Permian to Upper Cretaceous. Most of the Zone is represented by a thick series of alternating schists, sandstones, cherts and limestones interbedded with abundant ophiolithic effussives, and Upper Cretaceous flysch.

The *Zone of Vardar* is represented in a small part of the area (Island of Skyros) by Upper Jurassic ophiolites underlain by limestones of Triassic to Jurassic age.

Fig. 1 shows portions of three other sedimentary series that participate in the fabric of the area:

a) The *Zone of Parnass* with Upper Palaeozoic sediments and neritic limestones ranging in age from Triassic to Palaeocene.

b) The *Zone of Pindus* with mostly abyssal sediments of Triassic to Eocene age.

c) The *Zone of Tripolitza* with neritic limestones of Triassic to Middle Eocene overlain by flysch (Upper Eocene to Oligocene).

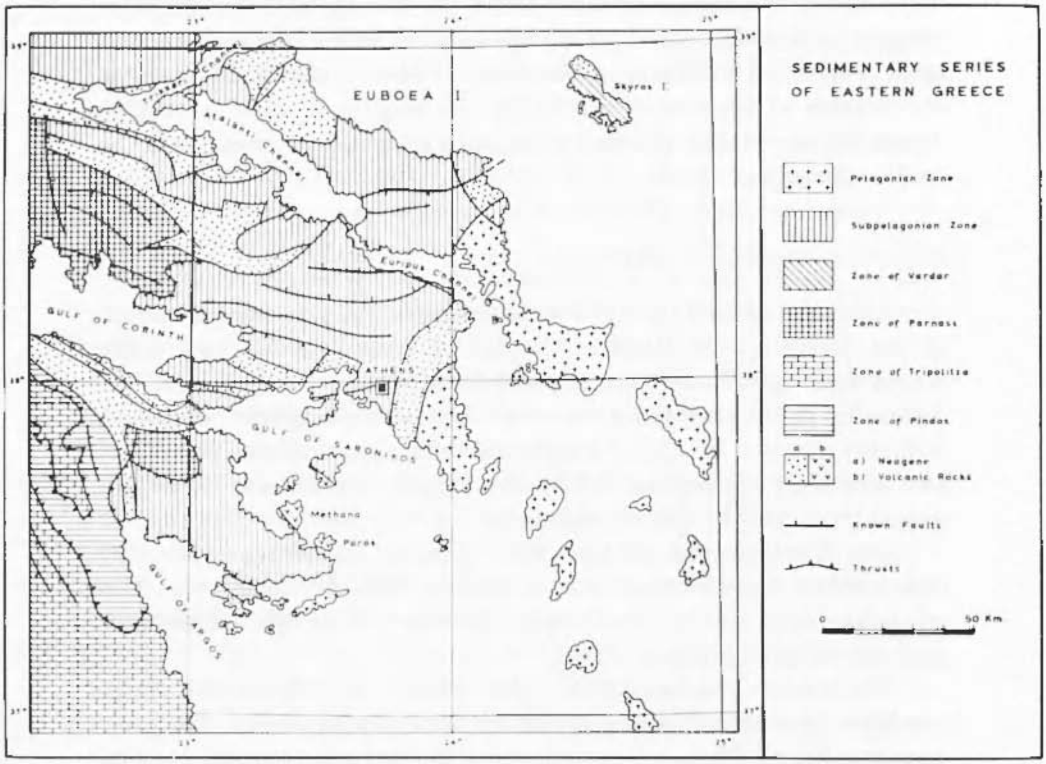

Fig. 1 – Structural map of the major region of Attica, after J. Bornovas (1970)

Folding and westward thrusting in eastern Greece began in Middle Mesozoic to Late Cretaceous and continued to Miocene (1,2,4,17,22). At the end of Oligocene, i.e. after the main Alpine orogeny, the topography of the area was greatly altered by rifting and subsidence. The Gulf of Corinth and Argos, the Saronikos Gulf, the channels of Trikkeri, Atalanti and Euripus, as well as the basins of Theves-Kopais, Attica, and Lemni-St. Anna in Euboea Island were formed by Miocene and post-Miocene dislocation. Shallow parts of grabens, rift valleys, fault-bounded basins and elongate closed depressions thus formed were filled up by interchanging strata of marly limestones and marls of Miocene age as well as sandstones and conglomerates of Pliocene and partly Pleistocene age. Later Quaternary strata of red argillaceous beds interbedded with conglomerates were deposited. In the foothills of the mountains the Alluvium consists of loose sand, pebbles and detritus.

Quaternary volcanic rocks are predominantly exposed in the islands of Aegina and Poros and in the Peninsula of Methana. The Methana Volcano was still active in 282 B.C..

Considerable development of vertical and strike-slip faulting for a distance of 55 kilometers was observed in the area of Atalanti Channel during the Locris earthquake in 1894.

DATA.

Data used for the above outlined study are listed in two Tables. Table II consists of earthquake foci that have been active since 1805 within a distance of 100 km of Athens. Data covering the period 1805 to 1950 were taken from a Table published by the author in 1963. The data of the period 1951 to 1964 were taken from an unpublished catalogue of shocks with $M \geqslant 4^1/_2$ occurred in Greece since 1951. The earthquake foci that have been active since 1965 were compiled from the USCGS cards of preliminary determination of epicenters.

Table III consists of earthquakes located by the National Seismological Stations Network within a distance of 100 km of Athens over a 4-year period, July 1965 through June 1969. The data were taken from the monthly preliminary bulletins of Athens. All magnitudes in Table III were calculated from the maximum trace amplitudes recorded by the standard Wood-Anderson instruments at Athens.

The data of Table III were completed by compiling: a) from the Wood-Anderson records all local shocks that were missed during the routine procedure, and b) from Benioff records all local shocks that were missed from the recordings of the Wood-Anderson instruments; the magnitudes were calculated from the maximum trace amplitudes of the Benioff vertical instrument reduced to the response of the Wood-Anderson instruments operated at the same location. The magnitudes assigned from the traces of the Benioff records are less accurate and the group of minor earthquakes may include some local quarry blasts. For lack of room the catalogue of the supplementary data is not published.

STATISTICS.

Data prior to 1805 are sparse; therefore, statistics are limited to the period 1805-1969. During the 120-year interval, 1805-1969, there were released from 57 foci, within a distance of 100 km from Athens,

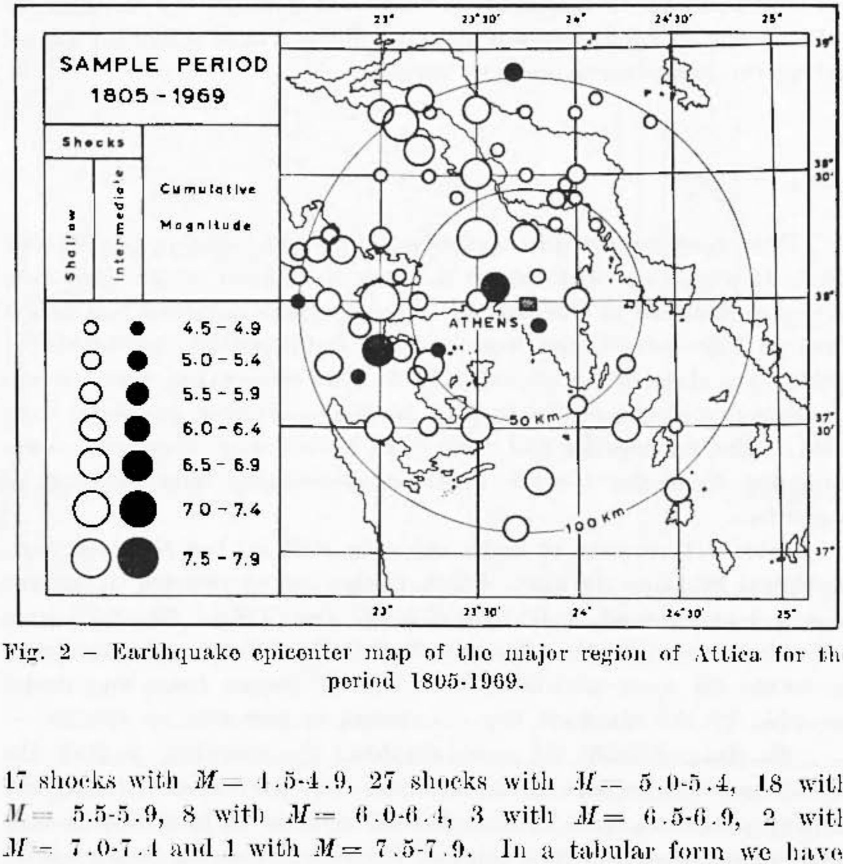

Fig. 2 – Earthquake epicenter map of the major region of Attica for the period 1805-1969.

17 shocks with $M = 4.5$-4.9, 27 shocks with $M = 5.0$-5.4, 18 with $M = 5.5$-5.9, 8 with $M = 6.0$-6.4, 3 with $M = 6.5$-6.9, 2 with $M = 7.0$-7.4 and 1 with $M = 7.5$-7.9. In a tabular form we have:

M	$4^1/_2$	5	$5^1/_2$	6	$6^1/_2$	7	$7^1/_2$
N_{120}	106	59	32	14	6	3	1
N_1	0.884	0.492	0.267	0.116	0.050	0.025	0.008
$\log N_1$	−0.059	−0.310	−0.574	−0.933	−1.301	−1.602	−2.078

where N_{120} and N_1 is the number of shocks of magnitude M or greater in 120-year period and per one year, respectively. These values fit rather closely to

$$\log N_1 = (3.05 \pm 0.14) - (0.67 \pm 0.06)\, M \,. \qquad [1]$$

If we drop the values for $M < 5^1/_2$, we find:

$$\log N_1 = (3.53 \pm 0.12) - (0.74 \pm 0.03)\, M \,. \qquad [2]$$

The fitting is better, but the change of b is within the limits of error. If we take into consideration only the shocks with $M \geqslant 4^1/_2$ occurred within a distance of 100 km from Athens during the period 1930-1969, we have 32 shocks with $M = 4.5$-4.9, 13 with $M = 5.0$-5.4, 9 with $M = 5.5$-5.9, 1 with $M = 6.0$-6.4 and 1 with $M = 6.5$-6.9. If we denote by N_{40} and N_1 the number of shocks of magnitude M or greater in 40-year period and per one year, respectively, we have

M	$4^1/_2$	5	$5^1/_2$	6	$6^1/_2$
N_{40}	56	24	11	2	1
N_1	1.40	0.60	0.275	0.050	0.025
$\log N_1$	0.14	—0.22	—0.56	−1.30	1.60

The data for this period fit to

$$\log N_1 = (4.80 \pm 0.18) - (1.00 \pm 0.08)\, M \,. \qquad [3]$$

There is now an appreciable change of b, but the M for $N_1 = 1$ is within the limits of error.

During the 4-year period, July 1965 through June 1969, there have been active 103 foci within a distance of 100 km of Athens; these foci released 4 shocks with $M = 1.0$-1.4, 10 with $M = 1.5$-1.9, 9 with $M = 2.0$-2.4, 71 with $M = 2.5$-2.9, 86 with $M = 3.0$-3.4, 32 with $M = 3.5$-3.9, 5 with $M = 4.0$-4.4, 2 with $M = 4.5$-4.9 and 1 with $M = 5.0$-5.4. Discarding the shocks with $M < 2^1/_2$, we have:

M	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5
N_4	197	126	40	8	3	1
N_1	49.3	31.5	10	2	0.75	0.25
$\log N_1$	1.69	1.50	1.00	0.30	—0.125	—0.60

The values fit to

$$\log N_1 = (4.30 \pm 0.18) - (0.98 \pm 0.09)\, M \qquad [4]$$

If we take into account the shocks missed during the routine procedure from July 1965 through June 1969, we have 340 shocks with $M = 1.0\text{-}1.4$, 138 with $M = 1.5\text{-}1.9$, 248 with $M = 2.0\text{-}2.4$, 221 with $M = 2.5\text{-}2.9$, 102 with $M = 3.0\text{-}3.4$, 34 with $M = 3.5\text{-}3.9$, 5 with $M = 4.0\text{-}4.4$, 2 with $M = 4.5\text{-}4.9$ and 1 with $M = 5.0\text{-}5.4$. Discarding the shocks with $M < 2$, we have:

M	2	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5
N_4	613	365	144	42	8	3	1
N_1	153.5	91.2	36	10.5	2	0.75	0.25
$\log N_1$	2.19	1.96	1.56	1.02	0.30	-0.12_5	-0.60

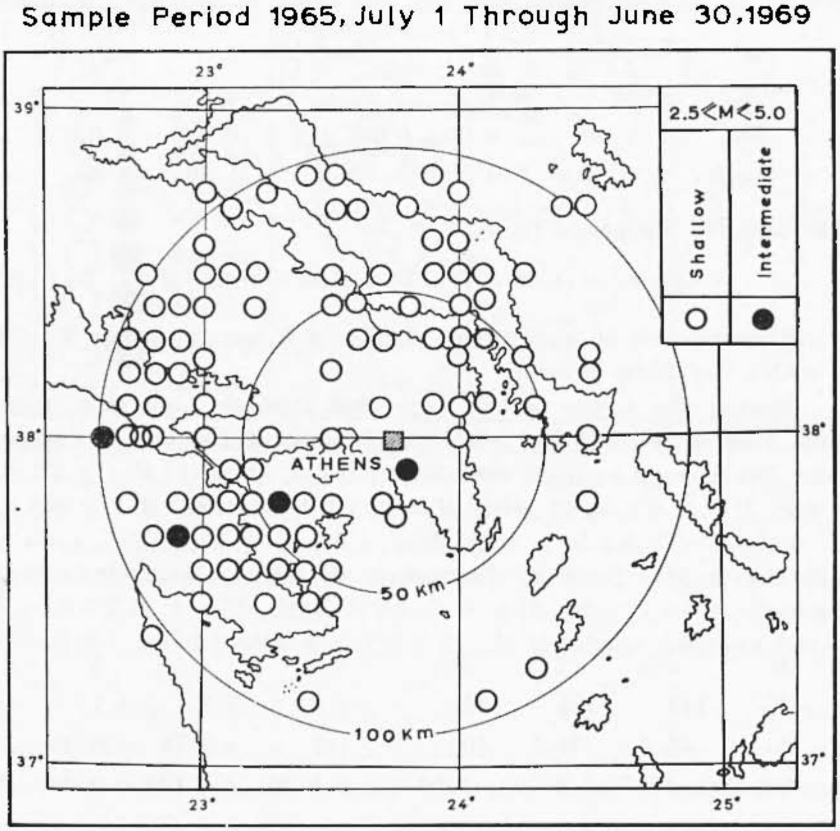

Fig. 3 — Earthquake epicenter map of the major region of Attica for the period 1965-1969.

The above values fit to

$$\log N_1 = (4.34 \pm 0.16) - (0.98 \pm 0.09)\, M\, . \qquad [5]$$

The minimum threshold of the $N(M)$-relation was lowered by one half unit without change of the a and b constants.

During the 4-year period, July 1965 through June 1969, there have been active 31 foci within a distance of 50 km of Athens; these foci released 4 shocks with $M = 1.0\text{-}1.4$, 9 with $M = 1.5\text{-}1.9$, 6 with $M = 2.0\text{-}2.4$, 17 with $M = 2.5\text{-}2.9$, 11 with $M = 3.0\text{-}3.4$, 5 with $M = 3.5\text{-}3.9$, and 1 with $M = 4.0\text{-}4.5$. Discarding the shocks with $M < 2^1/_2$, we have

M	$2^1/_2$	3	$3^1/_2$	4
N_4	34	17	6	1
N_1	8.50	4.25	1.50	0.25
$\log N_1$	0.94	0.63	0.17	—0.60

The values correspond to

$$\log N_1 = (3.68 \pm 0.28) - (1.04 \pm 0.10)\, M\, . \qquad [6]$$

Taking into account the shocks missed during the routine procedure from July 1965 through June 1969, we have 340 shocks occurred within a distance of 50 km from Athens with $M = 1.0\text{-}1.4$, 137 with $M = 1.5\text{-}1.9$, 95 with $M = 2.0\text{-}2.4$, 34 with $M = 2.5\text{-}2.9$, 14 with $M = 3.0\text{-}3.4$, 5 with $M = 3.5\text{-}3.9$ and 1 with $M = 1.0\text{-}4.4$. Discarding the shocks with $M < 1^1/_2$, we have:

M	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4
N_4	286	149	54	20	6	1
N_1	71.5	37.2	13.5	5	1.50	0.25
$\log N_1$	1.85	1.57	1.13	0.70	0.18	—0.60

The new values correspond to

$$\log N_1 = (3.50 \pm 0.20) - (0.96 \pm 0.11)\, M\, . \qquad [7]$$

Now the minimum threshold of the $N(M)$-relation was lowered by one unit and the constants a and b remained within the limits of error, without change of M for $N_1 = 1$.

In the case of the locatable shocks during the routine procedure the N_1 for $M = 0$ is about 4 times greater within 100 km than within

50 km from Athens. It is surprising that in the case we take into account the missing shocks the N_1 for $M = 0$ is about 7 times greater within 100 km than within 50 km from Athens. The discrepancy is removed if we drop the shocks with $M < 2$. In that case we have:

$$\log N_1 = (3.75 \pm 0.19) - (1.05 \pm 0.10)\, M \,. \qquad [8]$$

There is no marked change in the slope, but the N_1 for $M = 0$ is now again about 4 times greater within 100 km than within 50 km from Athens.

Taking into account the earthquakes missed from the recordings of the Wood-Anderson instruments, the local shocks detectable at Athens over the period July 1965 through June 1969 may be written in increments of $0.5\ M$ as follows:

Table I – LOCAL SHOCKS RECORDED BY THE BENIOFF VERTICAL SEISMOGRAPH AT ATHENS OVER THE PERIOD JULY 1965 THROUGH JUNE 1969.

M	$D \leqslant 100$ km	$D \leqslant 50$ km
0.5 - 0.9	19	19
1.0 - 1.4	477	477
1.5 - 1.9	210	209
2.0 - 2.4	303	124
2.5 - 2.9	252	43
3.0 - 3.4	106	15
3.5 - 3.9	34	5
4.0 - 4.4	5	1
4.5 - 4.9	2	—
5.0 - 5.4	1	—

Discarding the shocks with $M < 1.5$ for $\Delta \leqslant 100$ km and with $M < 1.0$ for $\Delta \leqslant 50$ km we have, respectively:

M	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5
N_4	913	703	400	148	42	8	3	1
N_1	228.25	175.75	100	37	10.50	2	0.75	0.25
$\log N_1$	2.36	2.24	2.00	1.57	1.02	0.30	−0.12	−0.60

M	1	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4
N_4	874	397	188	64	21	6	1
N_1	218.50	99.25	47	16	5.25	1.5	0.25
$\log N_1$	2.34	1.99	1.67	1.20	0.72	0.17	—0.60

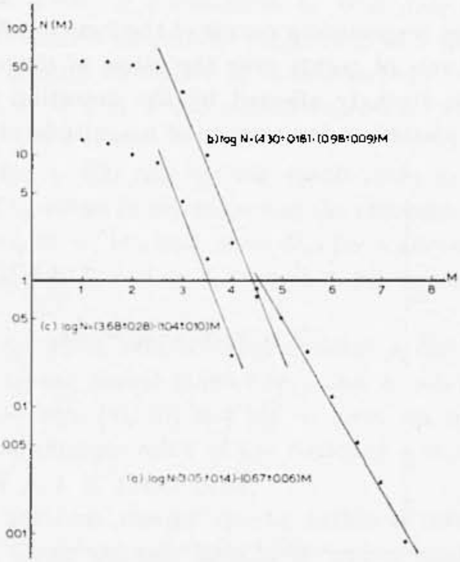

Fig. 4 – Cumulative frequency versus magnitude for the earthquakes located in the major region of Attica over the period: (a) 1850-1969; (b) 1965-1969; (c) in the minor region of Attica 1965-1969.

The above values correspond, respectively, to

$$\log N_1 = (3.99 \pm 0.24) — (0.89 \pm 0.11)\, M \qquad [9]$$

and

$$\log N_1 = (3.38 \pm 0.21) — (0.93 \pm 0.11)\, M\,. \qquad [10]$$

Thus, by adding the shocks missed from the recordings of the Wood-Anderson instruments, the minimum threshold of the $N(M)$-relation is lowered by another half unit. There is no change of M for $N = 1$, and the change of b is very small. Discarding the shocks with $M < 2$ for $\Delta \leqslant 100$ km, as well as for $\Delta \leqslant 50$ km, we get, respectively:

$$\log N_1 = (4.42 \pm 0.24) — (1.00 \pm 0.11)\, M \qquad [11]$$

and

$$\log N_1 = (3.82 \pm 0.21) — (1.06 \pm 0.11)\, M\,. \qquad [12]$$

Now there is a little change in the slope, and for $\Delta \leqslant 100$ km the M for $N_1 = 1$ remains almost the same.

DISCUSSION.

Straight lines representing curves of the form $\log N = a - bM$ were fitted to several sets of points over the range of magnitudes that appeared not to be strongly affected by the detection threshold. The data have been plotted in increments of magnitude of 0.5.

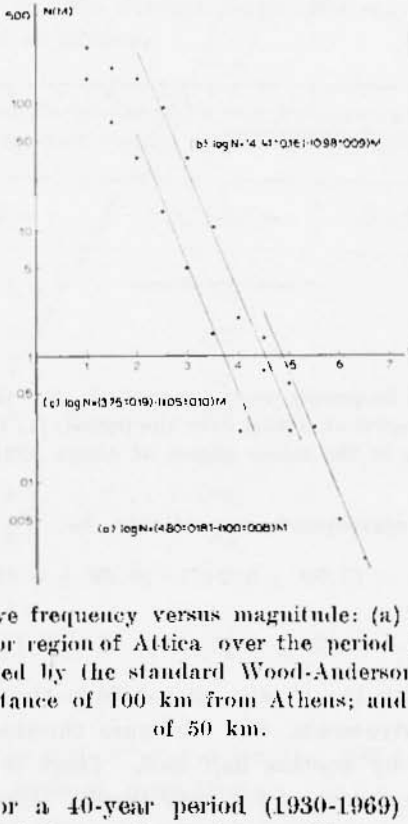

Fig. 5 - Cumulative frequency versus magnitude: (a) for the earthquakes located in the major region of Attica over the period 1930-1969; (b) for all local shocks recorded by the standard Wood-Anderson instruments (V = 2800) within a distance of 100 km from Athens; and (c) within a distance of 50 km.

The curve for a 40-year period (1930-1969) and a magnitude range of $4^1/_2$ to $6^1/_2$ has a slope of 1.0. The same slope shows the curve for a 4-year period (1965-1969) and a magnitude range of 2 to 5 (see Fig. 5). The two curves differ only in the constant a. The variance in the constant a $(4.80 - 4.34 = 0.46)$ indicates that the seismicity derived from a sample of a short period of observation, inadequate at the largest magnitudes, may be about 3 times smaller than that we get from a sample complete over all shocks recorded in a long period of observation.

The curve for a 120-year period (1850-1969) and a magnitude range of $4^{1}/_{2}$ to $7^{1}/_{2}$ has a slope of 0.67 (see Fig. 4). The constant a is very small ($= 3.05$), in comparison to that derived for a 4-year period (1965-1969) and a magnitude range of 2 to 5 ($a = 4.34$). The two curves show strong difference in both constants a and b, but the M for $N = 1$ is 4.57 and 4.42, respectively, i.e. within the limits of error of M.

The curve for a 120-year period (1850-1969) and a magnitude range of $5\frac{1}{2}$ to $7\frac{1}{2}$ differs in the slope and the constant a of the straight line fitted between $M = 4^{1}/_{2}$ and $M = 6^{1}/_{2}$ for a 40-year period (1930-1969), but the M for $N = 1$ is 4.77 and 4.80, respectively, i.e. virtually equal.

The curves for three sets of shocks within a distance of 100 km of Athens for a 4-year period (1965-1969) and a minimum threshold $2^{1}/_{2}$, 2 and $1^{1}/_{2}$ — eqs. [4], [5] and [9] — have an average slope of 0.95 ± 0.06. The average value of the constant a is 4.21 ± 0.22, and that of M for $N = 1$ is 4.42 ± 0.06.

The curves for four sets of shocks within a distance of 50 km of Athens for a 4-year period (1965-1969) and a minimum threshold $2^{1}/_{2}$, 2, $1^{1}/_{2}$ and 1 — eqs. [6], [7], [8] and [10] — have an average slope of 0.99 ± 0.06. The average value of the constant a is 3.58 ± 0.20, and that of M for $N = 1$ is 3.57 ± 0.07.

The scattering of the absolute value of b and of the "once per year" earthquake M in the major and minor region of Attica is relatively small and of the same order of magnitude. The scattering of the constant a is about three times larger. This indicates that the "once per year" earthquake M is a more reliable measure of seismicity than the constant a.

Comparing the average value of the constant a for the major and minor region of Attica ($4.21 - 3.58 = 0.63$), we could surmise that the seismicity of the major region is about four times greater than that of the minor region. Since the area of the major region is four times larger than that of the minor region, the earthquake activity per surface unit is nearly the same, i.e. virtually uniform over the whole area. The active earthquake foci in the minor region during the period 1965-1969 amount to 26. The active earthquake foci in the whole area total 103.

Table II – Earthquake foci that have been active over the period 1805 to 1969 within a distance of 100 km from Athens.

N°	Date	Location	Focal Depth km	Magnitude Adopted	Magnitude Cumulative
1	1968, April 25	38.0 °N, 22.6 °E	100	$4^{1}/_{2}$	
2	1962, Oct. 4	38.1 °N, 22.6 °E	n	$5^{1}/_{2}$	
3	1879, July 3	38.2 °N, 22.6 °E	n	5	
4	1953, June 13	38.2 °N, 22.7 °E	n	$5^{1}/_{2}$	
	1966, Sept. 1		n	$4^{3}/_{4}$	
	1967, June 12		n	$4^{1}/_{2}$	$5^{3}/_{4}$
5	1876, June 26	$37^{3}/_{4}$ °N, $22^{3}/_{4}$ °E	n	$6^{1}/_{4}$	
	1929, March 3		n	$5^{1}/_{4}$	$6^{1}/_{4}$
6	1877, July 2	38.0 °N, $22^{3}/_{4}$ °E	n	$5^{1}/_{2}$	
	1962, Jan. 7		n	$4^{3}/_{4}$	$5^{1}/_{2}$
7	1887, Oct. 3	$38^{1}/_{4}$ °N, $22^{3}/_{4}$ °E	n	$6^{1}/_{4}$	
	1894, March 26		n	$4^{3}/_{4}$	
	1926, July 2		n	$4^{3}/_{4}$	$6^{1}/_{4}$
8	1967, June 12	38.2 °N, 22.8 °E	n	$4^{3}/_{4}$	
9	1966, May 21	37.7 °N, 22.9 °E	117	$4^{1}/_{2}$	
10	1954, April 17	37.9 °N, 22.9 °E	n	$5^{1}/_{2}$	
11	1888, April 1	$37^{1}.5$ °N, 23.0 °E	n	$4^{3}/_{4}$	
	1898, Aug. 5		n	5	
	1922, Aug. 5	37.5 °N, 23.0 °E	n	5	
	Nov. 11		i	$5^{3}/_{4}$	
	1924, Febr. 16		n	$5^{1}/_{4}$	6
12	1962, Aug. 28	37.7 °N, 23.0 °E	120	$6^{3}/_{4}$	
13	1850, Jan. 13	38.0 °N, 23.0 °E	n	$4^{3}/_{4}$	
	1858, Febr. 21		n	$7^{1}/_{2}$	
	1899, Jan. 29		n	$4^{3}/_{4}$	
	1906, July 9		n	$4^{3}/_{4}$	
	1915, July 10		n	$4^{3}/_{4}$	
	1931, Jan. 4		n	$5^{1}/_{2}$	
	1962, Jan. 10		n	$4^{1}/_{2}$	
	1928, April 22	38.0 °N, 23.0 °E	n	$5^{1}/_{4}$	
	April 22		n	$6^{3}/_{4}$	
	April 24		n	5	
	April 25		n	$5^{1}/_{4}$	
	June 7		n	5	
	1953, Sept. 5		n	$5^{3}/_{4}$	$7^{1}/_{2}$
14	1941, July 29	$38^{1}/_{4}$ °N, 23.0 °E	n	5	
15	1961, Dec. 13	38.5 °N, 23.0 °E	n	$4^{1}/_{2}$	

Table II (cont.)

N°	Date	Location	Focal Depth km	Magnitude Adopted	Magnitude Cumulative
16	1916, Sept. 27	$38^{3}/_{4}$ °N, 23.0 °E	n	$5^{1}/_{2}$	
17	1966, Jan. 2	37.8 °N, 23.1 °E	n	$4^{3}/_{4}$	
18	1958, May 21	38.1 °N, 23.1 °E	n	$4^{1}/_{2}$	
19	1894, April 27	38.7 °N, 23.1 °E	n	7	
20	1968, July 4	37.7 °N, 23.2 °E	n	$5^{1}/_{4}$	
21	1928, April 29	38.0 °N, 23.2 °E	n	$5^{1}/_{4}$	
22	1894, April 20	38.6 °N, 23.2 °E	n	$6^{3}/_{4}$	
23	1947, April 19 1952, Oct. 13	38.8 °N, 23.2 °E	n n	$5^{1}/_{4}$ $5^{1}/_{2}$	$5^{3}/_{4}$
24	1922, Aug. 8	37.5 °N, $23^{1}/_{4}$ °E	n	$5^{1}/_{4}$	
25	1873, July 25 1930, April 17 Sept. 12 Sept. 12 Sept. 12 Sept. 15	$37^{3}/_{4}$ °N, $23^{1}/_{4}$ °E	n n n n n n	$6^{1}/_{4}$ $5^{3}/_{4}$ $5^{1}/_{4}$ $5^{1}/_{4}$ 5 $5^{1}/_{4}$	$6^{1}/_{2}$
26	1964, July 12	38.5 °N, $23^{1}/_{4}$ °E	n	$4^{3}/_{4}$	
27	1961, May 19	$38^{3}/_{4}$ °N, $23^{1}/_{4}$ °E	n	$4^{1}/_{2}$	
28	1968, June 17	37.8 °N, 23.3 °E	150	$4^{1}/_{2}$	
29	1952, Sept. 12	38.4 °N, 23.4 °E	n	$4^{1}/_{2}$	
30	1837, March 20 *	37.5 °N, 23.5 °E	n	6	
31	1893, Nov. 14 1926, Oct. 30	38.0 °N, 23.5 °E	n n	$4^{3}/_{4}$ $4^{3}/_{4}$	
32	1853, Aug. 18 1893, May 23 1914, Oct. 17 Oct. 17 Dec. 2 1917, Sept. 23 1962, Oct. 6	$38^{1}/_{4}$ °N, 23.5 °E	n n n n n n n	$7^{1}/_{4}$ 6 6 6 $5^{1}/_{2}$ $5^{1}/_{2}$ $4^{1}/_{2}$	$7^{1}/_{2}$
33	1864, July 17 1867, Jan. 2 1868, Dec. 28 1874, March 18 1902, April 11 May 1	38.5 °N, 23.5 °E	n n n n n n	$5^{1}/_{2}$ $5^{1}/_{4}$ $4^{3}/_{4}$ $5^{1}/_{2}$ $4^{3}/_{4}$ $4^{3}/_{4}$	$6^{1}/_{4}$
34	1885, Aug. 22	$38^{3}/_{4}$ °N, 23 °E.5	n	$5^{1}/_{4}$	

NOTE: Asterisk denotes shock not used in statistics (see N° 30-49).

Table II (cont.)

N°	Date	Location	Focal Depth km	Magnitude Adopted	Magnitude Cumulative
	1931, Sept. 11 Sept. 11 Sept. 13	$38^3/_4$ °N, 23.5 °E	n n n	$5^1/_4$ $5^1/_4$ 5	6
35	1964, July 17	38.05 °N, 23.6 °E	155	6	
36	1961, Sept. 5	38.6 °N, 23.6 °E	n	$4^3/_4$	
37	1957, May 29	37.1 °N, 23.7 °E	n	$5^1/_2$	
38	1964, Sept. 29	38.9 °N, 23.7 °E	89	$4^1/_2$	
39	1874, Jan. 17 1889, Jan. 22 1934, Jan. 2 1938, July 20 July 27 1957, Dec. 13	$38^1/_4$ °N, $23^3/_4$ °E	n n n n n n	$5^1/_2$ $4^3/_4$ $4^3/_4$ $5^3/_4$ 5 $4^1/_2$	$6^1/_4$
40	1962, Jan. 4	38.5 °N, $23^3/_4$ °E	n	$4^1/_2$	
41	1957, Apr. 2	$38^3/_4$ °N, $23^3/_4$ °E	n	$4^1/_2$	
42	1959, March 13	37.3 °N, 23.8 °E	n	$4^3/_4$	
43	1966, March 27	37.9 °N, 23.8 °E	179	$4^1/_2$	
44	1956, April 13	38.2 °N, 23.8 °E	n	$4^1/_2$	
45	1955, Febr. 9	38.3 °N, 23.9 °E	n	$4^1/_2$	
46	1919, Oct. 13	38.4 °N, 23.9 °E	n	5	
47	1961, March 6	38°27'N, 23°57'E	n	$4^1/_2$	
48	1956, Jan. 13	37.6 °N, 24.0 °E	n	$5^1/_4$	
49	1805, Nov. 16/17*	38.0 °N, 24.0 °E	n	$5^1/_2$	
50	1958, June 10	38.4 °N, 24.0 °E	n	$4^1/_2$	
51	1964, Oct. 27 1968, April 1	38.5 °N, 24.0 °E 38.5 °N, 24.0 °E	n n	$4^1/_2$ $4^1/_2$	5
52	1900, Jan. 12	$38^3/_4$ °N, 24.0 °E	n	$4^3/_4$	
53	1967, Aug. 28	38.3 °N, 24.1 °E	n	$4^1/_2$	
54	1965, March 9	38.8 °N, 24.1 °E	45	$4^1/_2$	
55	1891, May 11	37.5 °N, $24^1/_4$ °E	n	6	
56	1956, Jan. 18	$37^3/_4$ °N, $24^1/_4$ °E	n	$5^1/_4$	
57	1968, April 17	38.7 °N, 24.4 °E	n	$4^1/_2$	
58	1918, Jan. 17	$37^1/_4$ °N, 24.5 °E	n	$5^1/_2$	
59	1883, Aug. 5	37.5 °N, 24.5 °E	n	$4^3/_4$	

Comparing now the average values of the "once per year" earthquake M for the major and minor region of Attica ($4.42 - 3.57 = 0.85$), we could draw the conclusion that the seismicity of the major region is about 7 times greater than that of the minor region, i.e. the earthquake activity per surface unit in the outer region is two times higher than that in the inner region. The conclusion holds for shocks with $M \geqslant 2\frac{1}{2}$, i.e. for sampling equally complete for both regions; it is, therefore, much more close to the truth. The data points that establish the curves for the major and minor region of Attica (s. Fig. 6) remain on the line down to $M = 1.5$ and $M = 1.0$, respectively. This means that the lower bending of the curves is conditioned by the detection threshold. The difference in the detection threshold for the major and minor region does not affect the comparison of the individual levels of seismicity.

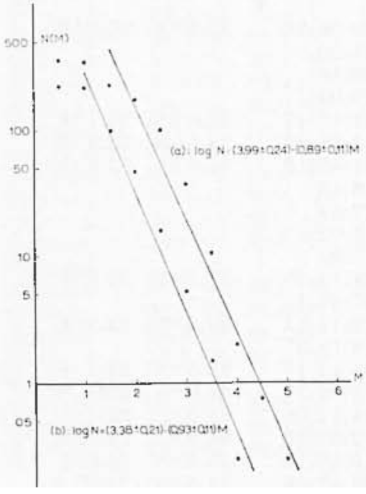

Fig. 6 – Cumulative frequency versus magnitude for all local shocks recorded by the Benioff vertical instrument ($V = 12.500$); (a) within a distance of 100 km from Athens; (b) within a distance of 50 km.

The upper bending of the curves is conditioned by the period of observation, i.e. is time dependent. The maximum magnitude observed in a region cannot be taken as feature or another measure of seismicity of the region. It may be logical to assume that in the regions of weaker seismicity a break-off of the earthquake recurrence curve occurs at smaller $M_{\max}$ values (²⁰); however, this is not always

Table III -- Earthquakes located by the National Seismological Stations Network over a 4-year period, July 1965 through June 1969, within a distance of 100 km from Athens.

Date	Origin	Location	Distance km	Magnitude M_L
1965, July 16	13:54:28	38.5 °N, $23^1/_4$ °E	70	3.3
17	16:02:22	38.0 °N, $22^3/_4$ °E	85	3.9
Aug. 17	11:38		15	3.1
» 20	02:47		90	3.0
Sept. 1	09:41		50	2.6
Oct. 21	18:29:03	$38^1/_4$ °N, 24.0 °E	60	2.6
Nov. 5	23:01:09	$37^3/_4$ °N, $23^1/_4$ °E	55	3.3
» 10	20:25:08	38.5 °N, $23^1/_4$ °E	70	3.1
Dec. 1	14:53:58	38.3 °N, 23.6 °E	35	2.9
» 4	04:08:40	38.1 °N, 23.7 °E	15	2.9
» 13	11:19:51	38.0 °N, 24.0 °E	25	2.7
» 24	01:09:54	38.4 °N, 22.8 °E	85	3.5
1966, Jan. 2	20:56:36	37.8 °N, 23.0 °E	65	3.9
» 2	21:30		65	2.4
» 2	22:19		(65)	2.5
» 2	23:03		60	2.5
» 2	23:12:17	37.8 °N, 23.1 °E	65	4.7
March 8	13:32:27	38.5 °N, 23.9 °E	70	3.4
» 27	01:49:12	37.9 °N, 23.8 °E	15	3.8
May 14	13:45		20	1.4
» 14	13:58		20	1.4
» 14	15:02		10	1.1
» 14	15:08		10	1.3
» 21	22:14:25	37.7 °N, 22.9 °E	80	3.4
June 4	07:51:41		20	2.5
» 16	18:14:54	38.4 °N, 23.8 °E	45	3.3
» 27	18:18:37		25	1.8
July 3	01:41:47	38.5 °N, 23.5 °E	60	3.0
» 5	18:02:17	38.0 °N, $22^3/_4$ °E	90	3.1
» 21	04:11:08	38.5 °N, 23.1 °E	60	3.0
Sept. 1	12:35:29	38.2 °N, 22.7 °E	90	3.9
» 1	13:10:13	38.3 °N, 22.8 °E	90	3.1
» 2	06:47:48	38.5 °N, 23 °E·0	90	3.1
» 3	09:48:40	37.2 °N, 24.1 °E	95	2.9
» 4	21:21:33	37.8 °N, 22.7 °E	95	2.8
» 7	00:23:06	38.2 °N, 23.5 °E	35	3.5
» 7	00:54:58	38.2 °N, 23.5 °E	35	3.0
» 15	22:11:15	38.1 °N, 22.7 °E	95	3.3
» 15	22:32:28	38.3 °N, 22.7 °E	95	3.8
Sept. 28	21:14:08	38.5 °N, 24.1 °E	70	2.7
Oct. 12	01:11:26	38.3 °N, 22.9 °E	80	3.0
» 16	05:47		10	1.6
» 17	00:51		15	1.6
» 27	23:46:22	37.6 °N, 23.0 °E	100	2.8
Nov. 11	09:52:12	37.2 °N, 23.4 °E	100	2.9
Dec. 14	20:29:42		90	2.9
» 28	20:08:17	38.1 °N, 23.9 °E	20	2.4

Table III (cont.)

Date	Origin	Location	Distance km	Magnitude M_L
1967, Jan. 10	10:35:24	38.4 °N, 23.0 °E	80	3.0
March 30	09:53:35	$38^1/_4$ °N, 23.0 °E	60	3.0
April 8	13:10		15	1.7
» 10	14:26		10	1.5
» 12	23:12:23	38.6 °N, 23.9 °E	70	3.9
May 26	13:15:38	38.0 °N, 23.5 °E	15	1.7
» 26	13:22		10	1.5
June 7	07:53:31	38.3 °N, 22.8 °E	90	3.7
» 8	00:03:16	38.2 °N, 22.7 °E	100	3.7
» 8	00:25:35	$38^1/_4$ °N, $22^3/_4$ °E	100	2.7
» 8	13:07:27	38.5 °N, $24^1/_4$ °E	60	3.1
» 8	19:58:13	38.0 °N, 22.7 °E	85	2.9
» 11	05:35:01	38.2 °N, 22.7 °E	95	3.8
» 11	10:00:19	38.0 °N, $22^3/_4$ °E	100	2.9
» 11	10:04:16	38.1 °N, 22.8 °E	85	3.2
» 11	13:31:15	38.5 °N, $22^3/_4$ °E	95	3.1
» 11	22:50:14	38.1 °N, 22.8 °E	90	3.3
» 12	01:29:05	38.2 °N, 22.7 °E	90	4.0
» 12	02:51:02	38.2 °N, 22.8 °E	90	4.4
» 12	11:00:14	38.1 °N, 22.8 °E	85	2.4
» 12	22:51:34	38.2 °N, 22.7 °E	95	3.4
» 15	13:23:37	37.4 °N, 22.8 °E	100	2.9
» 15	19:34:06	38.0 °N, $22^3/_4$ °E	(85)	2.8
» 16	17:46:30	$38^1/_4$ °N, 24.0° E	40	2.6
» 18	23:37:14	$38^1/_4$ °N, $22^3/_4$ °E	100	2.7
July 3	13:17:13	$38^1/_4$ °N, $22^3/_4$ °E	95	2.8
» 27	15:57:50	38.0 °N, 22.8 °E	80	2.8
Aug. 23	00:05:28		55	2.9
» 25	13:15:08	38.5 °N, 23.0 °E	85	3.1
» 28	02:33:49	38.3 °N, 24.0 °E	50	2.6
» 28	03:39:03	38.3 °N, 24.1 °E	55	3.7
» 28	03:43:12	38.3 °N, 23.9 °E	40	2.5
» 28	03:51		45	2.0
Oct. 10	17:32:27	37.7 °N, 22.8 °E	90	2.7
» 26	05:35:28	38.4 °N, 23.0 °E	80	2.9
Nov. 3	09:46:01	38.4 °N, 22.9 °E	80	2.8
1968, Jan. 16	08:32:59	38.0 °N, $22^3/_4$ °E	75	2.9
» 17	21:01:46	38.1 °N, 24.3 °E	55	3.1
» 17	23:22:05	37.8 °N, 24.5 °E	55	2.8
» 21	13:58:38	38.4 °N, 23.2 °E	70	3.7
» 28	22:49:18	37.5 °N, 23.0 °E	85	2.8
March 25	15:31:26	38.0 °N, $23^1/_4$ °E	25	2.5
» 30	11:50:04	38.8 °N, 23.5 °E	100	3.3
April 1	06:27:22	38.5 °N, 24.0 °E	65	4.4
» 6	12:26:46	38.2 °N, 24.5 °E	95	3.5
» 6	19:26:48	38.7 °N, 24.5 °E	100	3.3
» 6	23:34:26	$38^3/_4$ °N, 24.0 °E	100	3.0
» 7	03:41:55	38.7 °N, 24.4 °E	100	4.2
» 7	03:45:12	38.7 °N, 24.5 °E	100	3.5
» 13	14:48:54	38.6 °N, 23.9 °E	65	3.3

Table III (cont.)

Date			Origin	Location	Distance km	Magnitude M_L
1968,	April	25	10:34:04	38.0 °N, 22.6 °E	90	3.9
	May	4	09:36:54	38.4 °N, 23.6 °E	50	3.0
	»	19	09:18:12	38.4 °N, 24.1 °E	65	3.2
	June	11	13:52:04	37.5 °N, 23¼ °E	80	2.6
	»	17	11:16:38	37.8 °N, 23.3 °E	50	3.5
	July	4	21:47:51	37.7 °N, 23.2 °E	60	5.0
	»	4	22:42:04	37.6 °N, 23.1 °E	65	3.1
	»	4	23:04:30	37.7 °N, 23.2 °E	60	3.2
	»	4	23:28:27	37.7 °N, 23.0 °E	65	3.0
	»	4	23:33:23	37.7 °N, 23.1 °E	60	3.0
	»	5	00:37:56	37.7 °N, 23.3 °E	60	2.9
	»	5	02:12:30	37.7 °N, 23.2 °E	60	3.1
	»	5	02:26:48	37.8 °N, 23.2 °E	55	2.8
	»	5	04:42:46	37.8 °N. 23.2 °E	60	3.2
	»	5	11:44:38	37.6 °N, 23.2 °E	65	3.0
	»	5	14:56:57	37.7 °N, 23.3 °E	60	3.1
	»	5	15:08:45	37.7 °N, 23.2 °E	65	3.5
	»	5	15:14:56	37.7 °N, 23.3 °E	60	3.3
	»	5	15:19:50	37.8 °N, 23.1 °E	60	3.0
	»	5	17:49:23	37.6 °N, 23.3 °E	60	3.3
	»	5	20:12:20	37.8 °N, 23.1 °E	60	3.1
	»	5	21:05:15	37.7 °N, 23.2 °E	55	3.1
	»	5	22:25:52	37.6 °N, 23.4 °E	55	3.2
	»	6	01:13:48	37.6 °N, 23.3 °E	60	2.9
	»	6	05:24:44	37.6 °N, 23.3 °E	60	2.9
	»	6	08:02:51	37.6 °N, 23.3 °E	60	3.2
	»	6	16:25:54	37.6 °N, 23.3 °E	60	3.5
	»	6	17:30:51	38.2 °N. 22.9 °E	85	3.4
	»	6	19:45:43	37.6 °N, 23.3 °E	60	3.0
	»	6	21:55:32	37.7 °N, 23.2 °E	60	3.8
	»	6	22:20:25	37.6 °N, 23.3 °E	60	3.3
	»	6	22:43:23	37.7 °N, 23.3 °E	60	3.2
	»	7	00:51:16	37.7 °N, 23.1 °E	60	3.6
	»	7	01:27:05	37.7 °N, 23.1 °E	60	3.0
	»	7	05:44:07	37.7 °N, 23.0 °E	65	3.5
	»	7	08:14:27	37.5 °N, 23.4 °E	60	2.8
	»	7	10:03:29	37.8 °N, 23.1 °E	60	2.8
	»	7	16:08:10	37.8 °N, 23.2 °E	50	2.8
	»	7	22:29:17	37.6 °N, 23.2 °E	65	2.9
	»	8	07:15:13	37.8 °N, 23.2 °E	60	3.0
	»	9	14:32:50	37.8 °N, 23.5 °E	60	3.0
	»	9	16:49:59	37.7 °N, 23.2 °E	60	3.0
	»	10	03:48:04	37.8 °N, 23.1 °E	60	3.5
	»	10	05:32:05	37.7 °N, 23.2 °E	50	3.0
	»	10	16:22:13	37.8 °N, 23.1 °E	60	3.0
	»	10	21:36:29	37.7 °N, 23.2 °E	60	3.4
	»	10	23:29:34	37.8 °N, 23.2 °E	55	2.7
	»	11	05:50:29	37.6 °N, 23.2 °E	65	2.7
	»	12	10:21:00	37.8 °N, 23.1 °E	60	3.2
	»	13	14:50:16	37.8 °N, 23.1 °E	55	2.6
	»	13	17:31:02	37.8 °N, 23.1 °E	60	3.3

Table III (cont.)

Date	Origin	Location	Distance km	Magnitude M_L
1968, July 13	19:38:20	37.7 °N, 23.3 °E	50	3.4
» 14	16:26:51	37.6 °N, 23.3 °E	60	2.7
» 14	18:33:52	37.7 °N, 23.2 °E	55	3.6
» 16	00:54:43	38.7 °N, 23.5 °E	65	3.0
» 16	22:43:35	37.6 °N, 23.3 °E	60	2.9
» 21	14:40:27	38.5 °N, 23.7 °E	60	2.9
» 22	07:48:12	37.6 °N, 23.4 °E	50	3.9
Aug. 10	08:44:36	37.8 °N, 23.1 °E	60	3.4
» 15	01:07:15	38.4 °N, 24.0 °E	50	3.1
» 22	22:46:28	37.7 °N, 23.4 °E	50	2.6
» 23	12:21:36	37.7 °N, 23.2 °E	65	2.6
» 24	18:17:34	37.5 °N, 23.4 °E	65	3.2
» 26	00:24:20	37.7 °N, 23.3 °E	60	2.9
Sept. 3	22:59:59	37.7 °N, 23.2 °E	60	3.1
» 9	14:44:07	37.8 °N, 23.2 °E	55	2.6
» 12	10:36:30	37.8 °N, 23.2 °E	60	3.5
» 18	07:14:11	37.8 °N, 23.2 °E	60	2.9
» 18	14:18:22	38.4 °N, 23.6 °E	45	2.9
» 18	14:27:12	38.3 °N, 23.7 °E	40	3.3
» 19	15:08:59	$37^{3}/_{4}$ °N, $23^{3}/_{4}$ °E	60	2.9
» 22	09:55:27	37.8 °N, 23.1 °E	60	2.9
» 23	14:43:43	38.4 °N, 23.5 °E	40	3.3
Oct. 8	04:11:28	37.7 °N, 23.1 °E	60	2.5
» 12	08:53:57	38.8 °N, 23.9 °E	85	3.0
» 14	01:42:30	37.6 °N, 23.3 °E	65	3.9
» 14	03:02:51	37.4 °N, 23.5 °E	60	2.6
» 14	03:46:18	37.7 °N, 23.3 °E	60	2.6
» 14	07:59:21	37.7 °N, 23.3 °E	65	2.7
» 14	08:51:56	37.7 °N, 23.4 °E	60	2.7
» 14	17:08:02	37.9 °N, 23.2 °E	50	3.3
» 17	03:48:59	$38^{1}/_{4}$ °N, 24.5 °E	75	2.8
» 23	05:17:22	37.7 °N, 23.4 °E	55	3.0
» 23	12:20:17	37.8 °N, 23.1 °E	60	3.1
» 24	01:26:55	37.6 °N, 23.3 °E	60	3.6
» 24	04:34:44	38.1 °N, 24.0 °E	20	1.9
» 26	02:03:14	$38^{3}/_{4}$ °N, $23^{1}/_{4}$ °E	65	2.6
» 26	06:24:50	37.6 °N, 23.2 °E	70	2.7
» 26	06:27:46	37.6 °N, 23.4 °E	65	3.1
Nov. 2	22:58:38	37.6 °N, 23.3 °E	65	3.0
» 11	04:58:51	38.1 °N, 24.3 °E	55	3.2
» 16	15:38:43	38.0 °N, 24.5 °E	60	3.3
» 20	05:17:33	37.6 °N, 23.2 °E	60	3.3
» 20	19:46:50	38.5 °N, 23.9 °E	55	2.1
» 22	01:06:13	$38^{1}/_{4}$ °N, 24.5 °E	60	3.0
Dec. 10	20:13:23	38.5 °N, 23.0 °E	85	3.3
» 16	15:34:37	37.8 °N, 23.7 °E	25	3.3
» 17	03:38:48	38.8 °N, 23.4 °E	90	2.7
» 19	02:11:29	37.8 °N, 23.4 °E	30	2.7
» 25	04:19:20	38.1 °N, 23.0 °E	70	2.6
1969, Jan. 14	07:11:11	38.7 °N, 23.6 °E	80	3.1
» 17	08:35:28	37.7 °N, 23.2 °E	50	4.0

Table III (cont.)

Date	Origin	Location	Distance km	Magnitude M_L
1969, Jan. 18	17:32:10	38.7 °N, 23.1 °E	100	3.7
» 23	00:48:04	38.8 °N, 23.4 °E	90	2.9
» 24	00:52:24	37.5 °N, 23.5 °E	80	2.7
» 25	00:39:08	37.5 °N, 23.5 °E	60	3.1
» 29	22:16:29	38.5 °N, 24.0 °E	50	2.4
Febr. 13	09:23:32	38.6 °N, 24.0 °E	65	3.7
» 17	17:17:23	38.3 °N, 23.7 °E	30	2.1
» 18	11:52:58	38.3 °N, 23.7 °E	30	2.1
» 18	13:50	38.3 °N, 23.7 °E	30	1.9
» 23	16:54:29	38.7 °N, 23.5 °E	80	2.8
» 25	00:36:41	37.8 °N, 23.2 °E	50	2.4
» 26	06:06:28	38.0 °N, 23.0 °E	60	3.9
March 1	12:48:05	38.7 °N, 23.8 °E	80	3.1
» 20	06:54:39	37.3 °N, 23.4 °E	80	2.9
» 20	09:23:04	$37^{3}/_{4}$ °N, 23.0 °E	85	2.9
» 25	02:43:21	38.6 °N, 23.0 °E	90	2.7
» 25	03:21:06	$38^{3}/_{4}$ °N, $23^{1}/_{4}$ °E	90	2.7
» 25	04:37:02	38.5 °N, 23.0 °E	95	2.7
April 8	05:31:30	38.6 °N, 23.0 °E	85	3.3
» 13	09:36:04	38.1 °N, 24.1 °E	35	3.7
May 4	13:20:40	38.7 °N, 23.1 °E	95	3.2
» 30	19:45:28	37.7 °N, 23.4 °E	50	2.5
» 31	02:25:11	37.9 °N, 23.1 °E	50	2.9
June 7	20:53:08	37.8 °N, 22.9 °E	70	2.8
» 21	10:45:18	38.7 °N, 23.5 °E	75	3.4
» 25	06:06:29	38.1 °N, 23.7 °E	15	2.5
» 27	18:28:20	38.4 °N, 24.1 °E	50	2.6

observed. Great earthquakes are indeed commonest where the general level of seismicity is high but occasionally they occur in other regions where the general level of seismicity is pretty low (18). The Lisbon earthquake of November 1, 1755, with $M > 8\,{}^1\!/_2$, the New Madrid (Missouri) earthquakes on December 18, 1811, January 23 and February 7, 1812, and the Charleston (South Carolina) earthquake of August 31, 1886, with $M > 8$, illustrate fairly well the case.

The largest of the crustal shocks observed in the area of Greece ($M \geqslant 7\,{}^1\!/_2$) had their seat in the relatively stable, seismically poor, rigid crystalline mass, in the interior of the mobile Alpine orogenic belt (1904, April 4, $41^{3}/_{4}$°N, $23\,{}^1\!/_4$°E; 1912, August 9, $40^{1}/_{2}$°N, 27°E; 1956, July 9, 36.7°N, 25.8°E; 1968, February 19, 39.3°N, 25.0°E). No shallow shock with instrumental magnitude $M > 7\,{}^1\!/_4$ has ever occurred in the seismically very active area of Alpine folding.

It is worth noting that the major shallow earthquakes in the Aegean Sea (1956, July 9 and 1968, February 19) were both associated with very elongated, well delineated aftershock zones having a trend transverse to the Alpine belt. In general, shocks associated with old, transverse deep-seated lineaments in the area of Greece are relatively greater but less frequent than those genetically connected with longitudinal structural features of the area.

CONCLUSIONS.

From the above discussion and the comparison of the structural map with the earthquake epicenter map of the major region of Attica one might be allowed to draw the following conclusions:

(1) The reading of shocks within a distance of 50 km of Athens is essentially complete down to magnitude 1.5; average number of expected and observed shocks with $M \geqslant 1^1/_2$ per year 127 and 99, respectively.

(2) The threshold of reliable detection within a distance of 100 km of Athens is about $M = 2.0$; average number of expected and observed shocks with $M \geqslant 2.0$ per year 206 and 176, respectively.

(3) The lower bending of the straight lines representing curves of the form $\log N = a - b\,M$ is conditioned by the detection threshold. The maximum magnitude threshold is time dependent.

(4) The "once per year" earthquake M is a more reliable measure of seismicity than the constant a of the $N(M)$-relation. The "once per year" earthquake M is controlled by the period of observation much less than the constant a.

(5) Seismicity derived from a sample of a short period of observation inadequate at the largest magnitudes may be at least half as much smaller than that we get from a sample complete over all shocks recorded in a long period of observation.

(6) The maximum magnitude earthquake within a distance of 50 and 100 km of Athens per hundred years derived from a sample

period of 4 years is, respectively, 5.6 ± 0.2 and 6.4 ± 0.2. The maximum magnitude earthquake within a distance of 100 km from Athens per hundred years derived from a sample period: (a) of 120 years is 6.6 ± 0.1, and (b) of 40 years 6.8 ± 0.2.

(7) The active earthquake foci per surface unit in the Subpelagonian Zone and the other younger structural units appeared in the major region of Attica outnumber those appeared in the Pelagonian Zone.

(8) The distribution of earthquake foci in the Subpelagonian Zone and the other younger structural units of Attica is nearly uniform and reluctant to the surface dislocation.

(9) The active earthquake foci in the fault-bounded basin of Attica tend to cluster at the northern and southern outlets of the basin.

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