

<i>Bollettino della Società Paleontologica Italiana</i>	40 (2), 2001	ISSN 0375-7633	307-313	—	Modena, Giugno 2001
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Late Miocene - Pliocene mammalian faunas of Russia and neighbouring countries

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KEY WORDS – Mammal faunas, MN zones, Miocene-Pliocene, Former Soviet Union, Mongolia.

ABSTRACT – The data on the successions of the Late Miocene - Pliocene mammalian faunas from the territory of the former Soviet Union and Mongolia are summarised. The main characteristics of the MN zone for these territories are given.

RIASSUNTO – [Le Faune a mammiferi del Miocene Superiore e Pliocene della Russia e dei paesi limitrofi] – Gli autori riportano la successione delle faune a mammiferi dal Miocene superiore al Pliocene per l'area dei territori dell'ex Unione Sovietica e della Mongolia. Gli eventi faunistici riconosciuti vengono correlati con le unità faunistiche definite per l'Europa centro occidentale (unità MN). Nell'insieme, i dati relativi alle mammalofaune dei territori dell'ex Unione Sovietica e della Mongolia costituiscono il collegamento tra la successione faunistica dell'area Mediterranea (su cui è basata la zonazione MN) e la Cina. Dalle nostre analisi emerge che i rinnovamenti faunistici più profondi sono avvenuti alle transizioni Turoliano / Rusciniiano e Rusciniiano / Villafranchiano, come conseguenza del raffreddamento climatico globale ed i relativi profondi cambiamenti paleoambientali. In particolare, l'intenso raffreddamento globale pliocenico si manifesta con la comparsa delle prime forme boreali in Siberia alla transizione Rusciniiano / Villafranchiano. La differenziazione paleobiogeografica dell'area in esame, non ancora ben delineata nel Turoliano superiore, si stabilisce chiaramente nel Rusciniiano sino a divenire un chiaro provincialismo nel Villafranchiano.

INTRODUCTION

The intensive study of the Neogene mammalian faunas throughout Eurasia during the last decade permits the revision of the position of the principal faunas from the territories of the Former Soviet Union (FSU) and Mongolia in the geochronological scale and their correlation to MN zones. The data on the faunal successions of the FSU and Mongolia are very useful for better understanding the evolution and dispersal of faunas and their pan-Eurasian correlation.

In this paper, well represented reference faunas with magnetostratigraphical calibration were analysed. The biochronological correlation was based on the evolutionary stages of assemblages, the first appearance data (FAD), the evolutionary levels of dominant forms and on some phyletic lineages. The revision was based on investigation of L.Gabunia, A.Forsten, E.Korotkevitch, T.Krakhmalnaya, G.Meladze, Y.Semenov, M.Sotnikova, P.Tleuberdina, M.Pevzner, E.Vangengeim, A.Vekua, I.Vislobokova, V.Zhegallo and others. In addition to published data, we used new results, which were obtained by the revision of collections stored in the Paleontological and Geological Institutes, the State Geological Museum of the Russian Academy of Sciences, and Odessa State University.

TUROLIAN

The typical *Hipparion* faunas were widespread during Turolian time throughout the FSU and

Mongolia. Together with hipparions, other inhabitants of open landscapes, such as giraffids and antelopes, were dominant. They co-existed with woodland inhabitants (mastodonts, primates and others) and many other mammals. The faunal composition changed in time, reflecting the fluctuating character of the climate. The maximum aridification at the end of the Turolian is recorded by the disappearance of many Miocene forms and by faunal renewal through the appearance of immigrants and advanced species of autochthonous genera.

MN 11.

Reference locality: Grebeniki (Ukraine). Other locality: Udabno (Georgia) (Tab. 1).

The fauna is characterized by the FAD of *Ictitherium viverrinum*, *Miohyaenictitherium bessarabicum* (Semenov, 1989), *Eomellivora wimani wimani* (Wolsan & Semenov, 1996), *Promephitis maeotica*, *Metailurus* cf. *parvulus*, *Machairodus copei*, *Chilotherium schlosseri*, *Cervavitus variabilis*, *Palaeoryx* and *Gazella schlosseri*; the dominance of *Hipparion verae* and *H. giganteum* in the Northern Black Sea area (Krakhmalnaya, 1996), *H. garedzhicum* in Georgia and antelopes, and by a great diversity of mastodonts (Text-fig. 1). Among other forms *Mesopithecus pentelicus*, *Udabnopithecus*, *Promeles palaeattica* and *Adcrocuta eximia* are presented.

The normal polarity interval of the fossiliferous deposits in the Grebeniki site most likely belongs to the episode of normal polarity of Chron C4r.

AGE (Ma)	CHRONS	POLARITY	STAGE SUBSTAGE	FAUNAL UNITS	MN ZONES	RUSSIA (EUROPEAN PART) GEORGIA	UKRAINE MOLDOVA	TADJIKISTAN KYRGYZSTAN UZBEKISTAN	KAZAKHSTAN	RUSSIA (SIBERIA) MONGOLIA
			PLEISTOCENE							
2	C1r 2r									
	C2n									
	C2r	1 r 2r	UPPER	VILLAFRANCHIAN	MN-17	(-) Liventsovka, Khapry, Morskaya, Volovaya Balka	Zhevakhova gora	(-) Kuruksay (-) Tutak, Obigarm (-) Kairakkum	(-) Kopaly (lower level), (-) Podpusk-Lebyazh'e, (-) Adyrgan	Krestovka (lower level) Klochnevo 1, 2
3	C2An	1 r 2 r 3n	MIDDLE		MN-16	Uryv 1 (+) Kvabeby	Kotlovina (middle level)	(+) Djilgyndykoo (+) Akterek	Beteke 2, (-) Lebyazh'e 1, (-) Ostraya Sopka (-) Esekartkan	Beregovaya Shamar Udunga
4	C2Ar				MN-15	Kosyakino	(-) Odessa (Catacombs), (-) Etuliya, (-) Lucheshchy			Adycha
	C3n	1 n 2 r 3 n 4n	LOWER	RUSCINIAN	MN-14		Novopetrovka			(?) Ol'khon (Odonim) (?) Khirgis Nur 2 (levels 40-62)
5	C3r								Pavlodar 2	(?) Khirgis Nur 2 (levels 5-37)
6	C3An	1 n 2n			MN-13				(?) Kalmakpay	(?) Ol'khon (Sarai)
	C3Ar					(-) Bazaleti, (-) Kisatibi			(-) Pavlodar (Gusinyi Perelet)	Kholu
7	C3Bn						(-) Odessa (BF)			
	C3Br						(+) Cherevichnoe, Tudorovo, Belka,			
	C4n	1 n 2n	UPPER	TUROLIAN	MN-12		(+) Chimishliya, (+) Tarakliya, (+) Chobruchi 2, Novoelizavetovka, (-) Novaya Emetovka 2 (+) Grebeniki	Pedjikent, (?) Magian (Sor), Ortok (-) Daraispon		Altan Teli (middle level)
8	C4r	1 r 2r			MN-11					
9	C4An				MN-10	(?) Udabno			(+) 1 (-) 2 (≈) 3	

Tab. 1 - Correlations of major late Miocene-Pliocene mammal localities of Russia and neighbouring countries. Magnetization: 1 = normal, 2 = reversed, 3 = alternated.

MN 12.

Reference localities: Novoelizavetovka, Belka (Ukraine); Magian (Sor) (Tadjikistan); Altan Teli (middle level) (Mongolia). Other localities: Cherevichnoe; Novaya Emetovka 2 (Ukraine); Chimishlia, Taraklia, Chobruchi 2 (Moldova); Pedjikent, Daraispon (Tadjikistan); Ortok (Kyrgystan).

The most typical hipparion is *H. moldavicum* in the northern Black Sea area (Krakhmalnaya, 1996), and *H. mogoicum* and *H. placodus* in Mongolia (Zhegallo, 1978; Forsten, 1997). These faunas are also characterized by the FAD of *Hyaenictitherium parvum*, *Ictitherium pannonicum* (Semenov, 1989), *Chersonotherium* and *Cervavitus novorossiae*; by a wide distribution of *Machairodus giganteus*, *Hyaenotherium wongii*, *Felis attica*, *Cervavitus variabilis* and *Procapreolus*; by a great diversity of hipparions, giraffids and bovids; and by the last records of *Miohyaenotherium bessarabicum* and *Promephitis maeotica*. Among other forms are *Hyaenotherium wongii*, *Plesiogulo crassa* (Cherevichnoe), *Promeles palaeattica*, *Simocyon primigenius* (Chobruchi 2), and *Dinocrocuta gigantea* (Altan Teli, middle horizon).

The faunas of Ukraine and Moldova differ from the contemporaneous faunas of the Mediterranean area in the presence of some forms of Asiatic origin (such as *Procapreolus*) and a number of endemics. The fauna of Altan Teli (middle horizon) is close in composition to the Baode fauna from the Palearctic province of Qiu *et al.* (1999). The faunas from Tadjikistan and Georgia contain some Mediterranean elements (*Machairodus giganteus* and *Hipparion mediterraneum*) (Forsten, 1997; Sotnikova *et al.*, 1997).

MN 13.

Reference localities: Bazaleti (Georgia); Pavlodar (Gusinyi Perelet) (Kazakhstan); Khirgis Nur 2 (levels 5-37) (Mongolia). Other localities: Kisatibi (Georgia); Odessa (BF-Bolshoi Fontan) (Ukraine); Kalmakpay (Kazakhstan); Olkhon (Saraï) (Baikal Lake, Russia); Kholu (Tuva, Russia).

This was the time of great faunal turnover and of last records of many Miocene genera including most hyaenids (Werdelin & Solounias, 1991), some mustelids, *Machairodus*, *Felis attica* and others.

The *Hipparion mogoicum* group and *H. elegans* occurred in Kazakhstan and Mongolia, while the *H. mediterraneum* group was present in Georgia (Forsten, 1997). The faunas are characterized by the FAD of *Ictitherium ibericum* (Bazaleti), *Chasmaporthetes borisiaki* (Dermedzhy), cabaloid hipparions and *Paracamelus* (Odessa BF) (European part); *Prosiophneus licenti*, *Hyaenictitherium orlovi* (Kalmakpay), *Machairodus irtyschensis* (*horribilis* group), *M. kurteni* (*giganteus* group), "*Martes*" *anderssoni*; *Pavlodaria*, *Praesinomegaceros*, *Platycemas* and *Moschus* (Asian part) (Vislobokova, 1990); by the decreased diversity of mastodonts; by replacement of *Promephitis maeotica* by *artetii* group (MN 11-12) by *P. brevi-*

rostris/alexjewi group (MN 13) and of *Palaeotragus rouenii* (MN 11-12) by *P. asiaticus* (MN 13). Among other forms, a mustelid close to *Promeles* (Pavlodar and Kalmakpay), *Sivaonyx* cf. *lluecai*, "*Baranogale*" cf. *adroveri* (Kholu in Russia and Khirgis Nur 2 in Mongolia), *Eostyloceros blainvillei* and *Procapreolus latifrons* (Mongolia) were represented.

The faunas of the Baikal Lake area, Kazakhstan and Mongolia are very similar in composition to the contemporaneous faunas from the North Asian Province of Qiu *et al.* (1999). The fossiliferous deposits of Bazaleti, Kisatibi, Odessa (BF) and Pavlodar have a reversed polarity (Vangengeim & Pevzner, 1993). The deposits of Kalmakpay, Olkhon (Saraï) and Khirgis Nur 2 (levels 5-37) (Pevzner *et al.*, 1982) have alternating magnetization.

RUSCINIAN

The Ruscinian faunas of the European part of the FSU were recently revised (Pevzner *et al.*, 1996; Vangengeim *et al.*, 1998). These faunas (mainly from the northern Black Sea area) are similar in composition to the West European assemblages but included a considerable number of Asiatic elements. The faunas inhabited environments with a more continental climate than that of West Europe although the Ruscinian climate of the territory was more humid than in the terminal Turolian. In the Asian part of the FSU and Mongolia, the Asian species prevailed. In northern Siberia (Adycha) the first boreal form (*Gulo minor*) occurred at the end of the Early Pliocene (Sotnikova, 1982).

MN 14.

Reference localities: Novopetrovka (Kuchurgan beds) (Ukraine); Novaya Stanitz, Olkhon (Odonim) (Asian Russia); Khirgis Nur 2 (levels 40-62) (Mongolia). Other localities: Novaya Andriyashvka, Mikhailovka, Voinichevo, Yurovka (Kuchurgan beds) (Ukraine); Pavlodar 2 (Kazakhstan).

The faunas are characterized by the co-existence of large cabaloid and hipparionid hipparions. Among other forms, the faunas of the Northern Black Sea area contain primates *Macaca* and *Dolichopithecus* cf. *rusicinensis*.

The faunas from the Lake Baikal area and Mongolia are very close in composition to northern Chinese faunas and undoubtedly belonged to the same bio-province. The abundance of *Ochotonoides*, *Lophocricetus* and *Microtodon*, the last large muntiacines *Eostyloceros* and *Paracervulus* are typical for these faunas. They are also characterised by the FAD of *Eucyon* (Khirgis Nur 2, levels 40-62, and Olkhon, Odonim) migrated from America; by *Prosiophneus ericksoni*, and by the presence of *Sivaonyx* and *Plesihipparion* (another than *P. rocinantis*).

MN 15.

Localities: Khadzhi Abdul, Valeny, Gavanosy

MN Zone Taxon	MN11	MN12	MN13	MN14	MN15	MN16	MN17
Carnivora							
<i>Nyctereutes</i>			◆-----		-----	=====	=====
<i>Eucyon</i> -like forms			◆-----	◆~cf. davisii~	== sp.==	~~~ sp. ~	◆ kuruksaensis◆
<i>Canis</i> large form						?-----	=====
<i>Indarctos</i>	-----		~~~~~	◆			
<i>Ursus</i>				◆-----	--minimus--	=====	◆ = etruscus=
' <i>Martes</i> ' <i>anderssoni</i>			◆~~~~~	~?			
<i>Pannonictis</i>					◆-----	~~~~~	-----
' <i>Baranogale</i> ' <i>adroveri</i>	◆-----		~~~~ cf. ~	◆			
<i>Baranogale helbingi</i>				◆-----			
<i>Eomellivora wimani</i> ssp.	◆-----wimani-----			◆			
<i>Plesiogulo</i>	-----		~~~~~	-----	◆		
<i>Gulo minor</i>					? ~~~~~		◆
<i>Promeles palaeattica</i>	-----		~~~~sp.~	◆			
<i>Parataxidea</i>	◆-----		~~~~~	◆			
<i>Parameles</i>			◆-----		-----	~~~~~	◆
<i>Promephitis maeotica</i>	◆-----		◆				
<i>P. brevirostris</i> / sp.			◆-----	◆	◆-----sp.-----	◆	
<i>Sivaonyx lluecai</i>		◆-----	~~~~ cf. ~~~~~	~?			
<i>Simocyon primigenius</i>	◆-----		◆				
<i>Parailurus</i>					◆-----	~~~~sp.~	◆
<i>Ictitherium viverrinum</i>	◆-----		◆				
<i>Ictitherium pannonicum</i>		◆-----	◆				
<i>Ictitherium ibericum</i>			◆-----	◆			
<i>Hyaenotherium wongii</i>	◆-----	=====	◆				
<i>Miohyaenotherium</i>	◆~~~~~	◆					
<i>Hyaenictitherium</i>	◆---hyaenoides-----		◆~orlovi~	◆			
<i>Adcrocuta eximia</i>	=====	=====	◆				
<i>Chasmaporthetes</i>		◆-----	◆borissiaki-	◆	◆-----	~~~~ lunensis	~~~~~
<i>Pliocrocuta</i>					◆-pyrenaica	◆~~~~~perrieri	~~~~~
<i>Dinocrocuta gigantea</i>	-----	=====	◆				
<i>Metailurus parvulus</i>	◆---cf.---	◆-----	◆	◆			
<i>Machairodus</i>	◆---copei---	◆=giganteus=	◆~kurteni~	◆			
<i>M. irtyschensis</i>			◆=====	◆			
<i>Homotherium</i>					?-----	◆ davitasvili-◆	◆ crenatidens=
<i>Megantereon cultridens</i>					?◆-----	◆	~~~~~
<i>Felis attica</i>	-----	=====		◆			
<i>Lynx</i>					-----	=====	=====
<i>Acinonyx</i>						◆~~~~~	=====
Proboscidea							
<i>Deinotherium</i>	--giganteum--	-----		-----?			
<i>Tetralophodon</i>	---longirostris---	-----	◆				
<i>Gomphotherium</i>	-----						
<i>Zygodolophodon</i>	-----	◆-turicensis-	◆	-----borsoni-		◆~~~~◆	
<i>Choerolophodon</i>	---pentelici-	-----					
<i>Anancus</i>	-----	arvernensis-				◆	
<i>Archidiskodon</i>					?-----	-----	◆=gromovi=◆

MN Zone Taxon	MN11	MN12	MN13	MN14	MN15	MN16	MN17
Perissodactyla							
<i>Hipparion</i> (Hipparionid forms)	=====	=====	=====	=====	=====	~~~~~◆	
(Caballoid forms)				~~~~~	=====	=====◆	
<i>Equus</i>						◆~~~~~	=====
Artiodactyla							
<i>Palaeotragus</i>	-----rouenii-----	◆=asiaticus=◆	~~~~~	~~~~~	~~~~~	~~~~~◆?	
<i>Samotherium</i>		◆maeoticum-◆	irtyshensis =◆			~~~~~◆?	
<i>Sivatherium</i>							~~~~~
<i>Paracamelus</i>			◆-----	=alexejevi=	=====	~~~~~gigas	~~~~~
<i>Moschus grandaevus</i>			◆~~~~~◆				
<i>Paracervulus</i>				◆=====	◆		
<i>Eostyloceros</i>			~blainvillei~	◆=maci=	◆=====	◆	
<i>Procapreolus</i>	=====	=====	=====	=====	=====		
<i>Capreolus</i>						◆constantini◆	=====sp=====
<i>Pavlodaria</i>			◆~~~~~◆				
<i>Cervavitus</i>			=====	=====		~~~~~◆	
<i>Cervavitus variabilis</i>	◆-----			-----◆			
<i>Cervavitus novorossiae</i>	?-----		~~~~~◆				
<i>Eucladoceros</i>						◆-----	=====
<i>Orchonoceros</i>						◆~~~~~◆	=====
<i>Libralces gallicus</i>							◆=====
Alcinae gen. indet						◆~~~~~◆	=====
<i>Pseudalces</i>					◆-----	◆	
<i>Gazella</i>	=schlosseri=	=====◆	dorcadooides◆	=====	=====	◆sinensis~	~~~~~
<i>Antilospira</i>						◆~zdanskyi	~~~~~



Text-fig. 1 - Stratigraphical occurrence of late Miocene - Pliocene mammals of Russia and neighbouring countries. 1) FAD and LAD of taxa; 2) distribution in European part of the FSU; 3) in Asian part of the FSU and Mongolia; 4) in the FSU and Mongolia; 5) in other areas of Eurasia.

(upper part of Kuchurgan beds), Etuliya, Lucheshty, Musait, Novaya Karboliya, Novye Kirgany, Moskovai (Karboliya beds) (Moldova); Kosyakino (European Russia); Beteke (Algabab) (Kazakhstan); Adycha (Siberia, Russia).

Characterization: the FAD of *Hipparion tchikoicum* (Asian part of the FSU and Mongolia), *Gulo* (Adycha), *Croizetoceros* and *Cervus* (European part of the FSU); the predominance of voles compared to ochotonids, the last European occurrence of *Promephitis* (Lucheshty); the decrease of muntiacine abundance; the LAD of *Deinotherium* and a wide distribution of *Anancus arvernensis* and *Paracamelus* due to more arid climate than in the first half of the Ruscinian.

MN 15/MN 16.

Locality: Odessa (Catacombs) (Ukraine).

The fauna is characterized by the FAD of *Homotherium* and *Lynx*; by the presence of *Hipparion fissura* group (Gabuniya & Krakhmalnaya, 1993), *Plomys* ex gr. *kowalskii-hungaricus* (Topachevsky et al., 1987), "*Eucyon*" *odessanus*, *Baranogale helbingi*, *Parameles ferus*, *Pliocrocota pyrenaica*, *Chasmaporthetes lunensis odessanus* (Sotnikova, 1994), and by the abundance of *Paracamelus alexejevi*.

Reversely magnetized deposits of Odessa (Catacombs) correspond to the very end (terminal interval) of Gilbert (Vangengeim & Pevzner, 1991), Chron C2Ar.

VILLAGRANCHIAN

The transition from the Ruscinian to Villafranchian faunas was rather gradual in the European part of the FSU and more impressive in Siberia, where it was marked by the appearance of some boreal forms such as *Capreolus*. Together with *Gulo*, they co-existed with cercopithecoid primate *Parapresbytis*, mastodon *Zygolophodon* and red panda *Parailurus* (Udunga).

MN 16.

Reference localities: Kvabebi (Georgia); Uryv 1, Kotlovina (middle level) (European Russia); Udunga, Beregovaya (Asian Russia); Shamar (Mongolia). Other localities: Akterek, Djilgyndykoo (Kyrgystan); Esekartkan, Ostraya Sopka, Lebyazh'e 1, Beteke 2 (Kazakhstan).

Characterization: the FAD of *Mimomys* with tooth cementum, *Megantereon*, *Acinonyx* (Palearctic), *Arvernoceros*, *Eucladoceros* (European part), *Orchoceros*, *Antilospira*, *Gazella sinensis* (Central Asia), *Equus* (Lebyazh'e 1) and *Capreolus* (Udunga); the LAD of *Plesihipparion rocinantis/houfense*, *H. tchikoicum* (Shamar and Beregovaya), *Samotherium*, *Palaeotragus*, and *Cervavitus* (Esekartkan); the presence of *Hipparion crusafonti* and *Homotherium davitsvilii* (Kvabebi and Udunga); the abundance of *Ioribos* (close to *Leptobos*) and antelopes (Kvabebi); replacement of *Pliocrocuta pyrenaica* by *P. perrieri*.

The faunas of the Europe-Siberian subarea (Province) were very close in composition to those of Western Europe but differ in the presence of ochotonids and *Paracamelus*. To the east still more Central Asian forms occurred. The faunas of the Central Asian subarea were very close in composition to faunas of northern China (Vislobokova *et al.*, 1993).

MN 17.

Reference localities: Liventsovka, Khapry (European Russia); Kuruksay (Tadjikistan); Podpusk-Lebyazh'e (Kazakhstan). Other localities: Morskaya, Volovaya Balka (European Russia); Zhevakhova Gora (Ukraine); Tutak, Obigarm, Karamaidan (Tadjikistan); Kairakkum (Uzbekistan); Kopaly (lower level), Adyrgan (Kazakhstan).

Characterization: the FAD of *Archidiskodon gromovi*, large *Canis*, *Ursus etruscus*, *Stephanorhinus etruscus*; a wide distribution of *Equus stenonis* group, *Pliocrocuta perrieri*, *Homotherium crenatidens*, *Megantereon cultridens*, *Eucladoceros* and *Libralces*; the LAD of *Eucyon*-like dogs (*Eucyon* sp. from Podpusk-Lebyazh'e and "*Canis*" *kuruksaensis* from Kuruksay) and *Sivatherium* (Kuruksay).

CONCLUSIONS

The data on faunas from the territory of the FSU and Mongolia fill a gap between faunal sequences of

the Mediterranean area, where the MN units system was established, and China. The equivalents of all Turolian, Ruscinian and Villafranchian MN zones are represented in the studied territory with the best represented faunas being MN 12, MN 15 and MN 17 units.

The main renewals of mammalian faunas occurred at the Turolian/Ruscinian and Ruscinian/Villafranchian boundaries. They resulted from global cooling which led to fundamental changes of paleo-environment. Turnovers in faunal composition were also recorded at the MN 12/13 and MN 16/17 boundaries.

The paleobiogeographic differentiation that was not very clear in the early Turolian time, becomes more pronounced beginning from the Ruscinian with strong biogeographical provinciality in the Villafranchian.

The increasing amplitude of Pliocene global cooling was reflected in the appearance of the first boreal forms in Siberia at the very end of the Ruscinian (Adycha) and at the beginning of the Villafranchian (Udunga).

ACKNOWLEDGMENTS

The study was supported by the Russian Foundation for Fundamental Research (projects 98-04-49089 and 99-05-64150).

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(manuscript received October 18, 2000
accepted January 12, 2001)

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Finito di stampare
nel mese di Giugno 2001
presso
il Poligrafico Mucchi di Modena