THE IDENTITY OF *EUCALYPTUS SUBVIRIDIS* MAIDEN AND BLAKELY.

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(One Text-figure.)

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Synopsis.

*Eucalyptus subviridis** was first considered a hybrid between *E. cinerea and E. Blakelyi* because of its field occurrence and the segregation of juvenile characters in seedlings raised from it. It has also been synthesized by manipulation. The F1 is intermediate in many of its characters between the two parents and it grows as quickly as the slower growing parent, *E. Blakelyi*. Segregates which are near intermediate in morphology between the two parents in their characters are of lower viability than those which approach either parent. It follows that ecological sorting, if environmental conditions remain unchanged, would lead to the separate maintenance of the two species in the field even though they grow at times side by side and successfully hybridize.

Eucalyptus subviridis is one of a group of species described by Blakely which is hybrid. This species occurs always in the vicinity of stands of *E. cinerea*, where they are in contact with a stand of "red gum",† usually *E. Blakelyi*. At the line of junction *E. subviridis* is found occasionally. Several trees have been located near the type locality in the vicinity of Marulan, and others north of Yass. It is presumably of *E. cinerea* × *E. Blakelyi* parentage. The trees are moderately vigorous in the field, but several have been seen which, by the time they are about 35 feet tall and probably 20 to 30 years old, are unthrifty and one has died during the period of five years in which it has been under observation.

The tree is intermediate between the putative parents in most of its characters. The principal contrasting characters between *E. cinerea* and *E. Blakelyi* together with the comparable ones of *E. subviridis* are shown in Table 1.

Table 1.

	Bark.	Mature Leaves.	Buds.	Fruit.
E. cinerea ..	Rough.	Sessile, opposite and glaucous.	Threes.	Turbinate, valves level with rim.
E. Blakelyi	Smooth.	Alternate, petiolate and lanceolate.	Generally 7 or 11.	Hemispherical, valves strongly exserted.
E. subviridis	Rough halfway up trunk.	Sub-opposite, shortly petiolate, moderately glaucous, ovate-lanceolate.	Basal flower clusters usually 3, later ones mixed numbers.	Sub-hemispherical, valves moderately exserted.

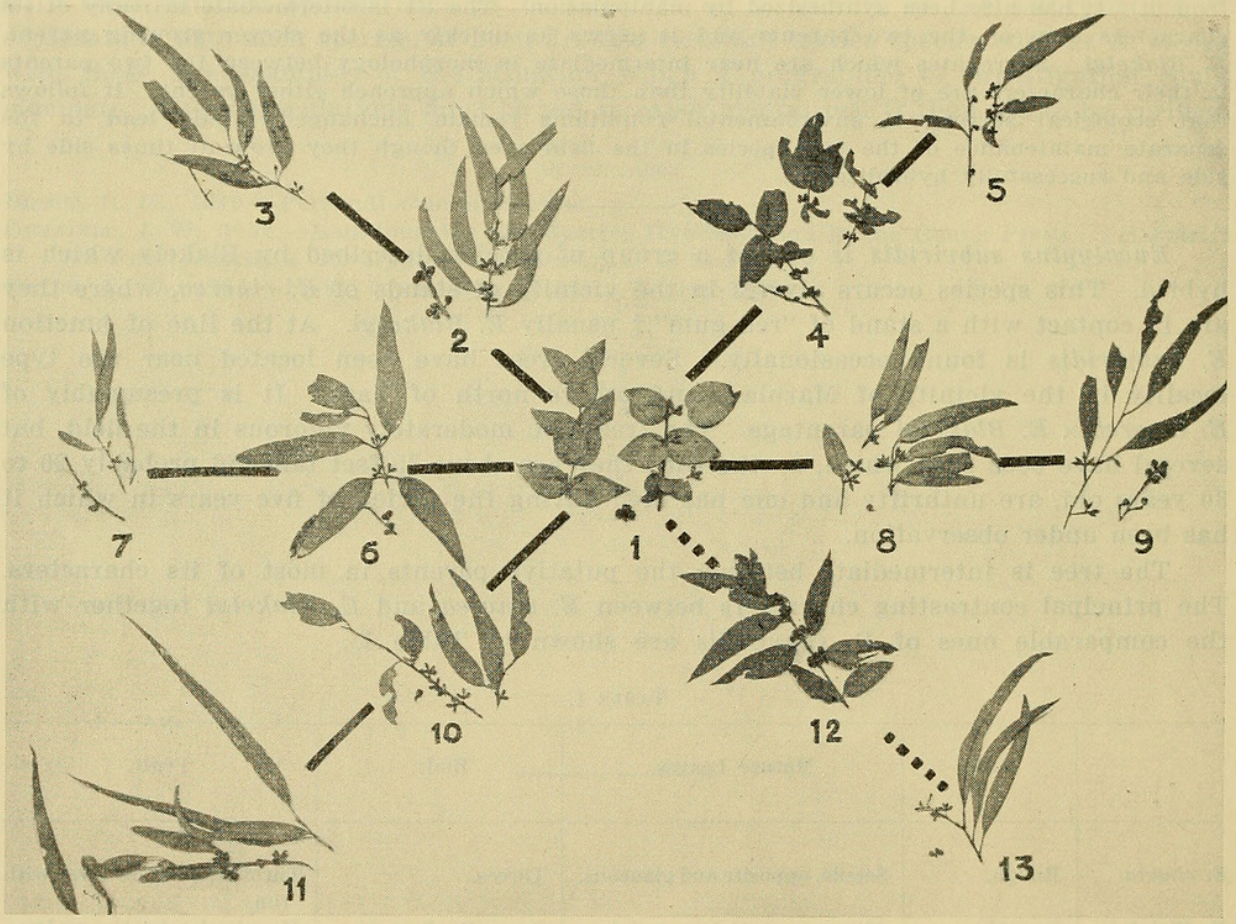
Progeny raised from *E. subviridis* segregates very strongly in its juvenile characters, giving various combinations, from individuals resembling either presumed parent to various intermediates between them. The rate of growth of individuals in the progeny is very variable. This is a character many hybrid progenies share, the degree of variance in height growth often being much greater in hybrid combinations than in pure species.

Successful synthesis of this hybrid by manipulated pollination was achieved. The cross, *E. cinerea* × *E. Blakelyi*, and the reciprocal were both successful, giving a small

* Nomenclature as in Blakely's "Key to the Eucalypts", 1934.

† The term "red gum" is used here to denote a species of the series Exsertae.

number of F1s in both cases which are now six years old. In the juvenile stage the F1 hybrids are intermediate in most characters between the two parents as is the adult tree, but it shares apparent dominance in the same characters as does the F1 hybrid *E. cinerea* × *E. robusta* (Pryor, 1954). In particular, the leaves tend to remain opposite though shortly petiolate, and the square stem of *E. Blakelyi* persists. On the other hand glaucousness and leaf shape are approximately intermediate. The vigour of growth assessed by height at five years of age does not differ statistically from that of the slower growing parent, in this case and at this age, *E. Blakelyi*. So far the F1s have not flowered, except one precocious flower cluster which formed on one individual. The bud shape was intermediate between the two parents. The F1s are matched closely by some of the segregates in progeny from *E. subviridis*. There is little doubt, therefore, that *E. subviridis* is either the F1 between *E. Blakelyi* and *E. cinerea*, or some segregates from it.



1, *cinerea*; 2, *cinerea* × *viminalis*; 3, *viminalis*; 4, *cinerea* × *Macarthuri*; 5, *Macarthuri*; 6, *cinerea* × *rubida*; 7, *rubida*; 8, *cinerea* × *Blakelyi*; 9, *Blakelyi*; 10, *cinerea* × *Bridgesiana*; 11, *Bridgesiana*; 12, *cinerea* × *maculosa*; 13, *maculosa*.

Text-fig. 1.—Shows specimens of hybrids of *E. cinerea* with *E. viminalis*, *E. rubida*, *E. Bridgesiana*, *E. Blakelyi*, *E. maculosa* and *E. Macarthuri*. The dotted line to the *E. maculosa* was made because the progeny test had not at the time confirmed the supposition that the specimen was hybrid. It has since been confirmed. The persistence of opposite (though shortly petiolate) leaves in the hybrids is noticeable.

E. cinerea × *E. Blakelyi* is one only of a series of hybrids which *E. cinerea* forms in the field with species of the Macrantherae-Normales wherever it comes into contact with them. This may be seen on the Hume Highway between Collector and Moss Vale. Several of these have been examined and distinct segregation is obtained in progeny raised from individuals suspected of being hybrid between *E. cinerea* and, successively, *E. Bridgesiana*, *E. maculosa*, *E. viminalis*, *E. Macarthuri* and *E. rubida* (see Text-fig. 1).

It seems that *E. cinerea* is homozygous for opposite, sessile, glaucous, orbicular leaves in the mature state. It is also a fully rough-barked species. Individuals which occur fringing stands of *E. cinerea* which depart from this character by the development of petiolate and somewhat lanceolate leaves or with relatively smooth bark may in most cases be reckoned hybrid, and progeny raised from them segregates distinctly in all cases tested. This material is particularly suitable for the investigation of hybridism because of the ease of detecting hybrids in it. Combinations with *E. Macarthuri* are of special interest because of the characteristic oil present in *E. Macarthuri* and an analysis of the inheritance displayed by the progeny from this combination in relation especially to oil inheritance will be set out elsewhere.

The present study is one of the few recorded cases in which a "species" first located and examined in the field, progeny tested and determined as hybrid, has subsequently been confirmed in diagnosis by the synthesis of the hybrid by manipulated pollination. There remains only the raising of an F2 generation to complete a fully rigorous examination of the genetic status of *E. subviridis*. As a hybrid between *E. Blakelyi* and *E. cinerea* it should not be described as a species. The other five hybrids mentioned are about as common and can be found from time to time at stand junctions between *E. cinerea* and the other parent concerned, but they have never been formally described or named.

The material displays one other point which may be a common feature in *Eucalyptus*. The juvenile characters are so distinctly different in the two species that seedlings which are old enough to have produced 8 pairs of leaves can be assessed according to four contrasting characters, i.e., glaucous, orbicular, opposite, sessile leaves in *E. cinerea* and green, ovate, alternate, petiolate leaves in *E. Blakelyi*.

TABLE 2.

Progeny 50/702 E. cinerea × E. Blakelyi (*Six Months Old*).

	cinerea														*Blakelyi*	
No. of *cinerea* characters	4	3	3	3	3	2	2	2	2	2	2	1	1	1	1	0
Combination	sessile	s	s	s	p	s	s	s	p	p	p	s	p	p	p	petiolate
	glaucous	g	g	gr	g	g	gr	gr	g	g	gr	gr	g	gr	gr	green
	opposite	op	alt	op	op	alt	op	alt	op	alt	op	alt	alt	op	alt	alternate
	orbicular	lanc	orb	orb	orb	lanc	lanc	orb	lanc	orb	orb	lanc	lanc	lanc	orb	lanceolate
V=11		1	–	–	–	–	–	–	–	–	–	–	3	–	–	1	V=vigorous
M= 4		5	–	1	2	–	–	–	3	1	–	–	4	–	2	1	M=medium vigour
R= –		1	–	1	1	–	1	–	2	1	–	–	–	–	–	–	R=runt
		15	7	0	2	3	0	1	0	5	2	0	0	7	0	2	2
				27				8						11			
Vigorous:		12=45%					0= 0%						4=36%				
Medium:		12=45%					4=50%						7=64%				
Runts:		3=11%					4=50%						0= 0%				

Table 2 shows the classification of 46 individuals in a progeny from a tree of *E. subviridis* according to all the possible recombinations of the eight contrasting characters. The assessment is a little over-simplified as glaucousness and leaf shape are probably inherited "multiplefactorially" and not as Mendelian single-gene controlled characters. This means that the recombinants listed with non-glaucous leaves and with non-orbicular leaves are less in number than would be expected if there were simple Mendelian inheritance. Nevertheless the table gives a useful approximate assessment of the position of each segregate in the range between the parental extremes.

The individuals in each group are also assessed in three classes of vigour: Vigorous, Medium and Runts. The runts are obviously unthrifty and presumably are the result of gene combinations which are poorly viable. Many of these die as soon as they leave the nursery and are subjected to the more rigorous field conditions.

The implication from Table 2 is that recombinants in this hybrid progeny, which are near intermediate in their inheritance from either parent, are less viable than those which approach either parent. This condition indicates a substantial degree of genetic isolation of the two species which would aid the maintenance of each, even when they come in contact in the field and form hybrids. In short the gene combination of each species is of superior survival value to intermediates between them.

The facts suggest that F1 hybrids when they arise have a fair chance of survival because they are, in the early stages at least, as fast growing as the slower growing parent, *E. Blakelyi*. However, when an F2 generation is produced the individuals which survive will be those which resemble most closely either parent, the morphology presumably being closely tied to physiological characteristics too, so that the site factors which operate to keep the two stands separate will quickly lead to the sorting of the segregates. Thus, on the site carrying the *E. Blakelyi*, those approaching *E. Blakelyi* will tend to survive and the others will be eliminated, and vice versa. The possibility of gene flow from one population to the other exists, but it appears that the factors which have operated in the past to keep these two species separate will continue to operate and that the two populations will remain separate, as distinct species, unless some entirely new environmental situation arises which might lead to the emergence of a gene combination derived from both species which would be more successful than either of them in a habitat at present not available but which also might emerge in the future.