

Insemination related factors affecting fertilization in estrus-synchronized cattle



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What did you do with all those sperm?



Elements we should consider

Sperm Transport in cow

- Rapid
- Sustained

Bull

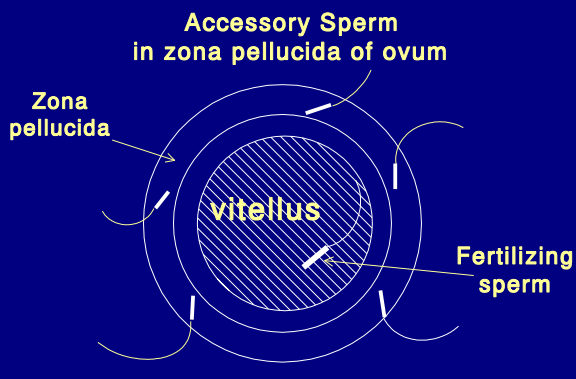
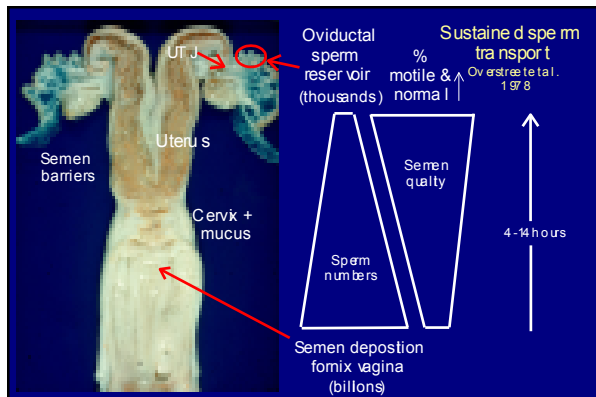
- Reproductive history
- Source of preserved semen

Inseminator

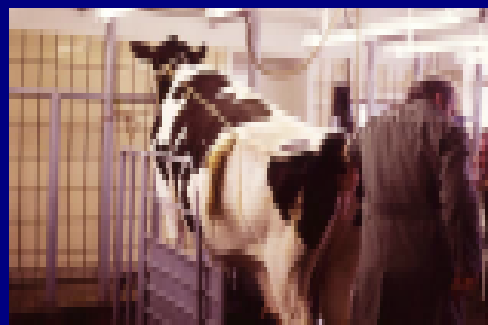
- Insemination skill-placement
- Semen handling

Timing of insemination

- Time and tightness of ovulation
- Method of detecting heat/ovulation



Sixth day non-surgical embryo recovery (single or super) (presumptive embryo, compact morula)



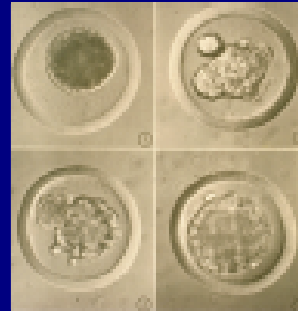
Functionality: Accessory sperm? partial answer



- Select population
- Oviduct reservoir
- Egg recognition
- Partial penetration
- Fertilizing??

UFO and viable embryos at day 6 (bovine)

UFO



Poor

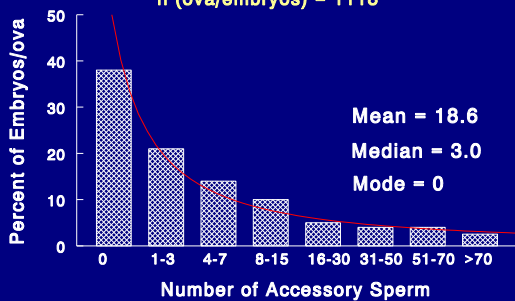
Fair

Good to Excellent

2x preg

Under and Wright, 1988.

Accessory Sperm Distribution
(Single Ovulating Bovine)
n (ova/embryos) = 1118



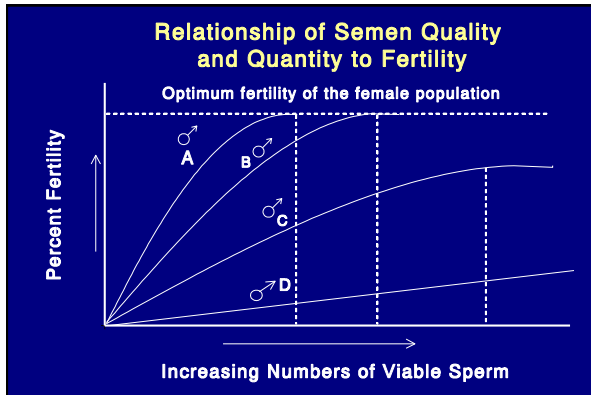
Relationship of accessory sperm per embryo/ovum to fertilization status and embryo quality (n=1118)

Fertilization status/ Embryo quality	n	Mean ± SD	Median
Excellent/good	534	26.2 ± 47.3	8
Fair/poor	245	18.9 ± 40.4	5
Degenerate	105	16.9 ± 40.8	1
Deg/UFO	14	2.4 ± 5.3	0
Unfertilized	220	1.5 ± 14.8	0

Efforts to raise accessory sperm number

Effort	Outcome	Reference
•Block sperm loss	0 effect	DeJarnette et al., 1992
•Frozen v Fresh semen	0 effect	Nadir et al., 1993
•Seminal plasma	0 effect	Nadir et al., 1996
•Extender (milk/EY)	0 effect	Dalton, et al. 1996
•Microencapsulation	- effect	Munkittrick et al., 1992
•Semen dosage	0 to +++	Nadir, et al., 1993
•Site of insemination	+ (deep)	Dalton, et al., 1997
•Select male	++++	Nadir, et al., 1993
•Natural service,	0 to ++++	Dalton, et al., 2001
•Time of AI, sing.super	+++	Dalton, et al., (01-02)
•Male x time of AI	+++	Serolli, et al., Unpubl
•Fr/Fz semen x AI time	0 effect	Serolli, et al., Unpub

Bull Effect



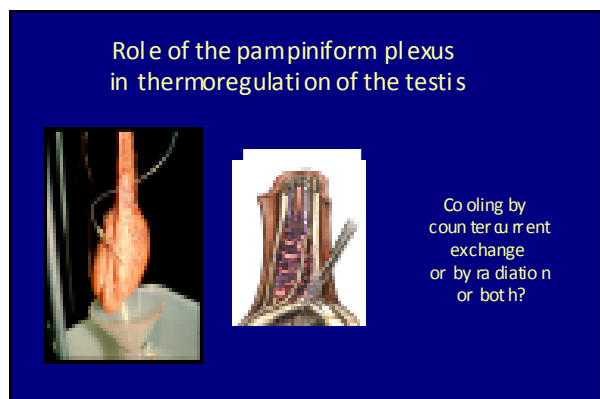
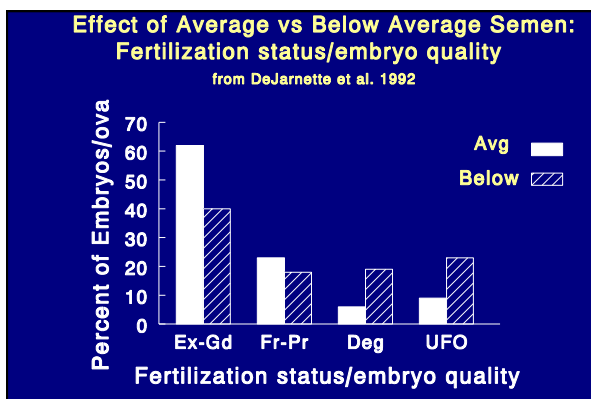
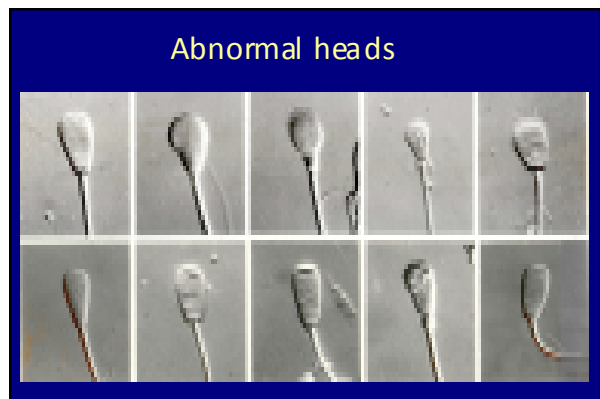
Compensable seminal deficiencies
 Those deficiencies which can be overcome by increasing sperm dosage
 preclude sperm access to ovum?

Uncompensable seminal deficiencies
 Those deficiencies resulting in depressed fertility at any sperm dosage
 Signify incompetence of fertilizing sperm?

Accessory sperm differences per embryo/egg among bulls used at the same insemination dosage

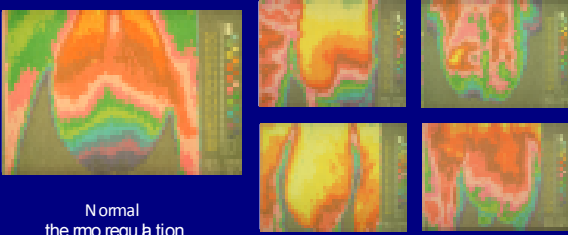
Bull	n	Median	Mean ± SD
A	25	40*	52 ± 6.1
B	37	8	15 ± 2.3
C	16	13	36 ± 6.5
D	20	2	11 ± 1.6

Nadr et al. 1993



Infra red thermograms of bull testes

Kastelic, et al. 1996

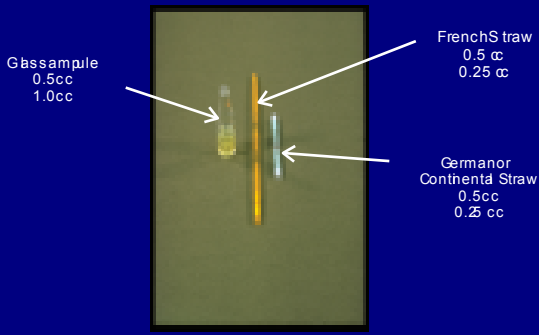


Normal thermoregulation

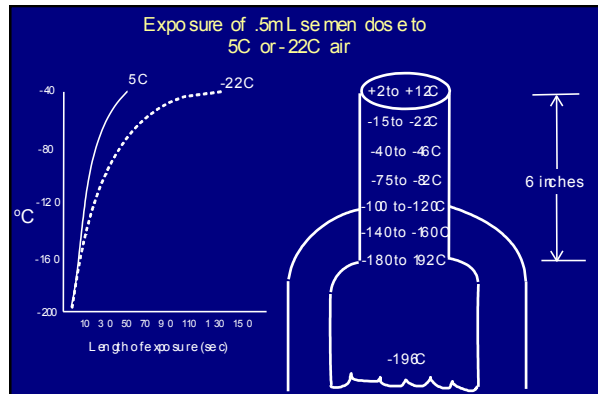
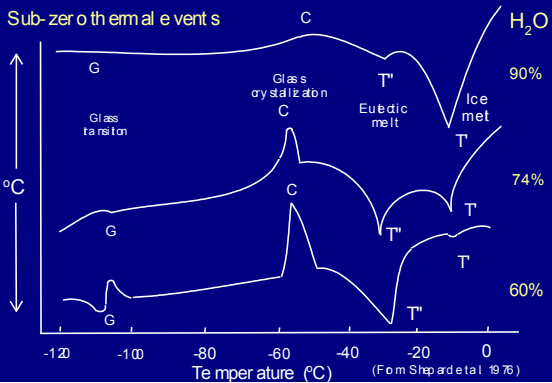
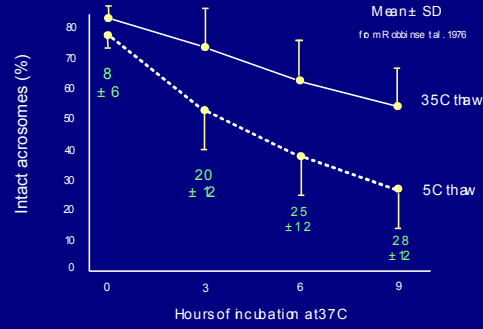
Abnormal thermoregulation

Inseminator

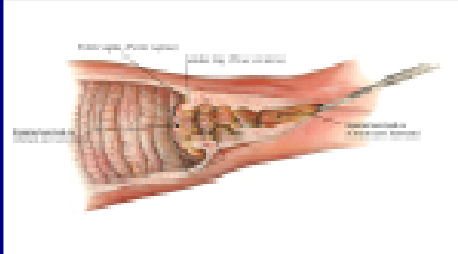
Forms of the Artificial Insemination Dose (frozen semen)



Effect of thaw-bath temperature on acrosomal integrity



Cervical Anatomy (Sperm barrier)



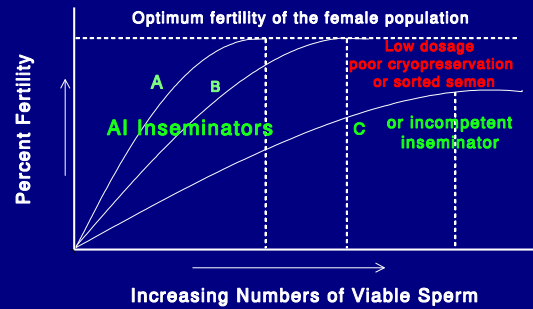
Site of Dye Deposition in Cows In Vivo (Graham, EF, 1966)

Site of dye deposition	Conception rate of technicians	
	<70% NR	>78% NR
	%	%
Body of the uterus	34	86
Right horn	31	14
Left horn	4	0
Anterior cervix	9	0
Posterior cervix	16	0
Vagina	6	0

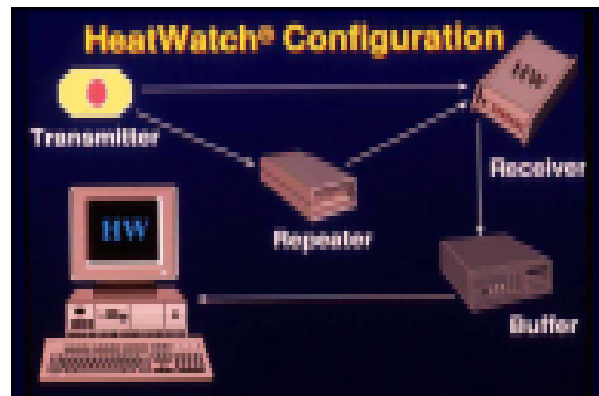
Effect of sperm dose on conception rate (From Hunter, WK, 1968.)

	Sperm per dose			
	20,000,000		10,000,000	
	Services	Non-returns	Services	Non-returns
High Conception Technicians	2,885	82.3%	2,875	81.1%
Low Conception Technicians	2,670	80.0%	2,996	71.2% **
Totals	5,555	81.0%	5,871	76.1% **

Relationship of Semen Quality and Quantity to Fertility



Time of insemination



Accessory sperm data
in relation to time of insemination
utilizing Heatwatch $\text{\textcircled{A}}$

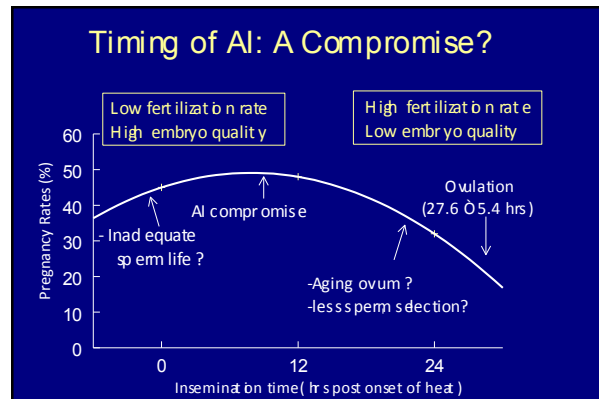
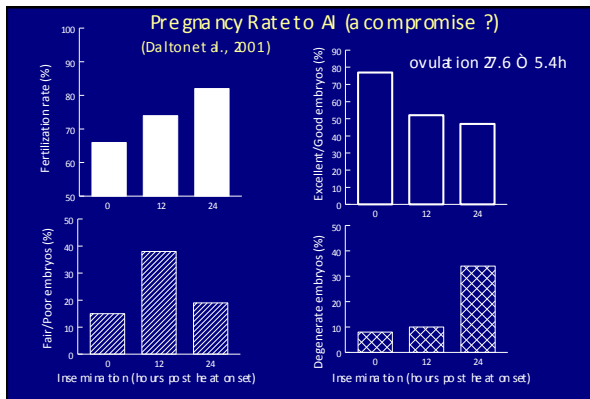
Source	Breed	Estrus	Time of ovulation after 1st standing event
Dalton et al., 2001	Holsteins	PGF or spontaneous	27.6 \pm 5.4 hours
Serolli et al., unpubl.	Angus	GnRH + 7 day CIDR +PGF on d 6	31.0 \pm 2.9 hours

Effect of artificial insemination time
on accessory sperm per embryo or ovum
(breeding time post onset of estrus
based on HeatWatch System $\text{\textcircled{A}}$)

Experiment 1 (Dalton et al., 2001)				Experiment 2 (Serolli et al., unpubl)			
Treatment	n	Mean \pm SD	Median %	Treatment	n	Mean \pm SD	Median %
0 hour	39	9 \pm 23	1	Hour 4	45	12 \pm 24	1
12 hour	39	21 \pm 46	2	Hour 24	41	35 \pm 60	15
24 hour	39	33 \pm 53	4				

•Ovulation 27.6 \pm 5.4 hours
 •25 x 10⁸ sperm/dose

•Ovulation 31.0 \pm 2.9 hours
 •70 - 100 x 10⁸ sperm/dose

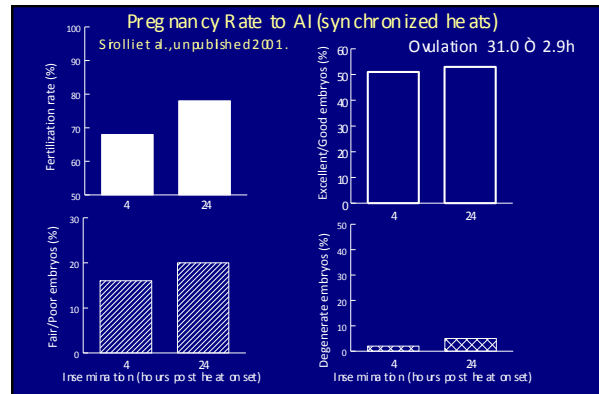


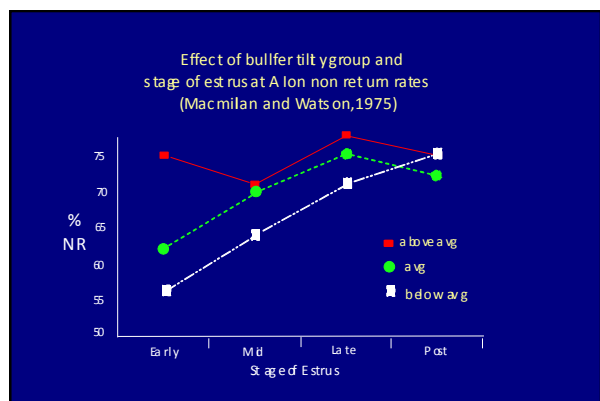
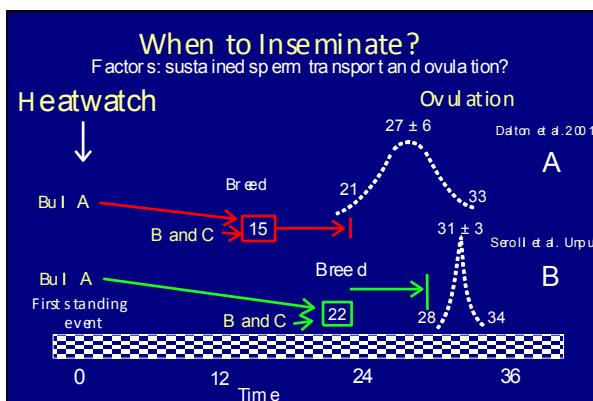
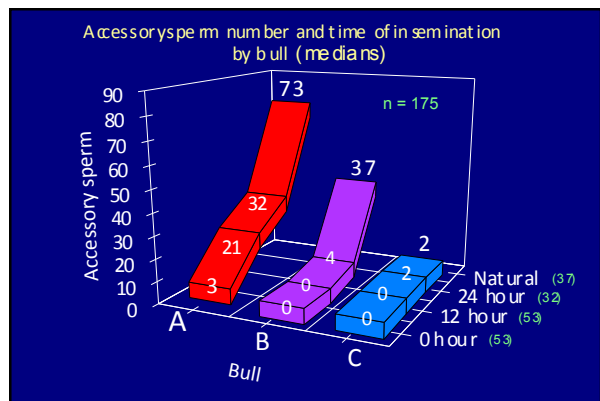
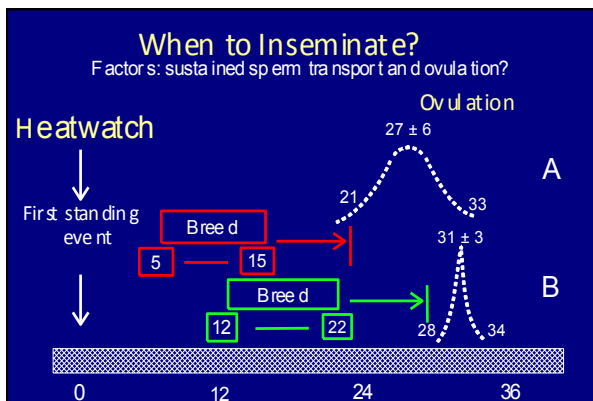
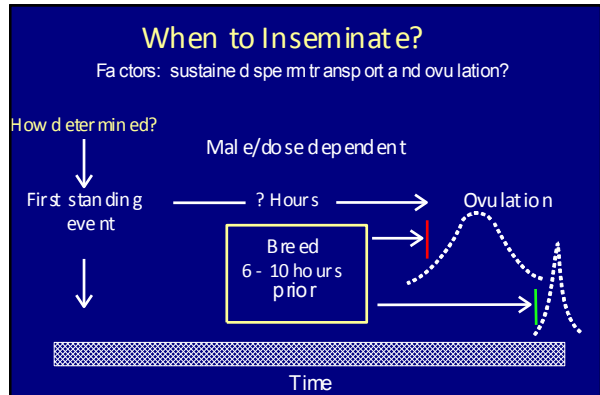
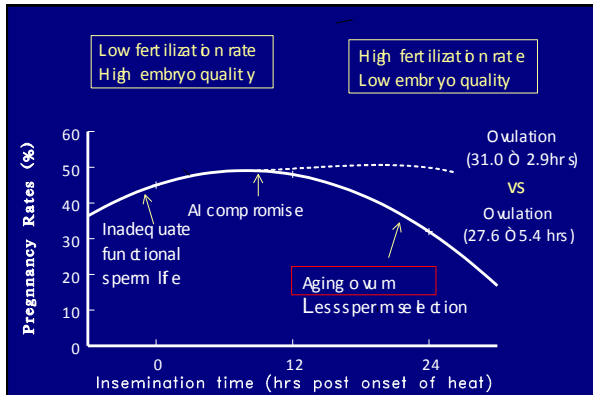
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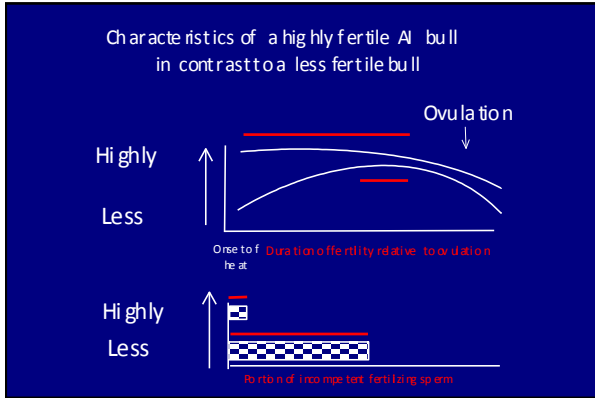
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Summary

Bull

- Reliable semen source (bull history, BSE data)
- Minimize uncorrectable deficiencies (sperm morphology)
- Successful cryopreservation

Inseminator

- Trained in semen handling and placement
- Retained?

Time of insemination

- Know time and tightness of ovulation
- Inseminate 6-10 hours prior to onset of ovulation (sustained sperm transport)

Acknowledgements

Male research in:

- Accessory sperm
- Embryo quality
- Testicular thermoregulation
- Sperm chromatin

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