International Recognition for WW LC

Science, Technology and Innovation for the 21st Century Meeting of the OECD Committee for Scientific and Technological Policy at Ministerial Level, 29-30 January 2004 - Final Communique

They noted the **worldwide consensus of the scientific community, which has chosen an electron-positron linear collider** as the next accelerator-based facility to complement and expand on the discoveries that are likely to emerge from the Large Hadron Collider currently being built at CERN. They agreed that the planning and implementation of such a large, multi-year project should be carried out on a global basis, and should involve consultations among not just scientists, but also representatives of science funding agencies from interested countries. Accordingly, Ministers **endorsed the statement prepared by the OECD Global Science Forum Consultative Group on High-Energy Physics**:

A **roadmap** that identifies four interdependent priorities for global high-energy physics (HEP) facilities:

-The exploitation of current frontier facilities until contribution of these machines is surpassed

- Completion and full exploitation of the **Large Hadron Collider at CERN**

- Preparing for the development of a **next-generation electron-positron collider**

M. Tigner LP2003

R1: R&D Needed for a Feasibility Demonstration of the Machine

R1 'Score Card': Is a Feasibility Demonstration Required* ?

	Modulators	Klystrons	RF Distribution	Accelerator Structures
TESLA	No	No	No	No (500 GeV) Yes (800 GeV)
NLC/JLC-X	No	No	Yes	Yes
JLC-C	No	No	Yes	Yes
CLIC	Yes	Yes	Yes	Yes

TABLE 2: Sumn

	TESLA		JLC-X/NLC[a]	
Center of mass energy [GeV]	500	800	500	1000
RF frequency of main linac [GHz])	1.3		11.4	
Design luminosity [10^{33} cm^{-2}s^{-1}]	34.0	58.0	25.0 (20.0)	25.0 (30.0
Linac repetition rate [Hz]	5	4	150 (120)	100 (120)
Number of particles/bunch at IP [10^{10}]	2	1.4	0.75	
$\gamma\varepsilon_x^* / \gamma\varepsilon_y^*$ emit. at IP [m·rad × 10^{-6}]	10 / 0.03	8 / 0.015	3.6 / 0.04	
β_x^* / β_y^* at IP [mm]	15 / 0.40	15 / 0.40	8 / 0.11	13 / 0.11
σ_x^* / σ_y^* at IP [nm] before pinch[c]	554 / 5.0	392 / 2.8	2 243 / 3.0	219 / 2.1
σ_z^* at IP [μm]	300		110	
Number of bunches/pulse	2820	4886	192	
Bunch separation [nsec]	337	176	1.4	
Bunch train length [μsec]	950	860	0.267	
Beam power/beam [MW]	11.3	17.5	8.7 (6.9)	11.5 (13.8
Unloaded/loaded gradient[d] [MV/m]	23.8 / 23.8[e]	35 / 35	4 65 / 50	
Total number of klystrons	572	1212	4064	8256
Number of sections	20592	21816	12192	24768
Total two-linac length [km]	30	30	13.8	27.6
Total beam delivery length [km]	3		3.7	
Proposed site length [km]	33		32	
Total site AC power[f] [MW]	140	200	243 (195)	292 (350)
Tunnel configuration[g]	Single		Double	

Technology Choice

The International Linear Collider Steering Committee (ILCSC) has successfully completed the selection of the twelve members of the International Technology Recommendation Panel (ITRP):

Asia:	Europe:	North America:
G.S. Lee	J-E Augustin	J. Bagger
A. Masaike	G. Bellettini	B. Barish (Chair)
K. Oide	G. Kalmus	P. Grannis
H. Sugawara	V. Soergel	N. Holtkamp

First meeting end of January at RAL (27/28 January)

Recommendation of one technology before end of 2004

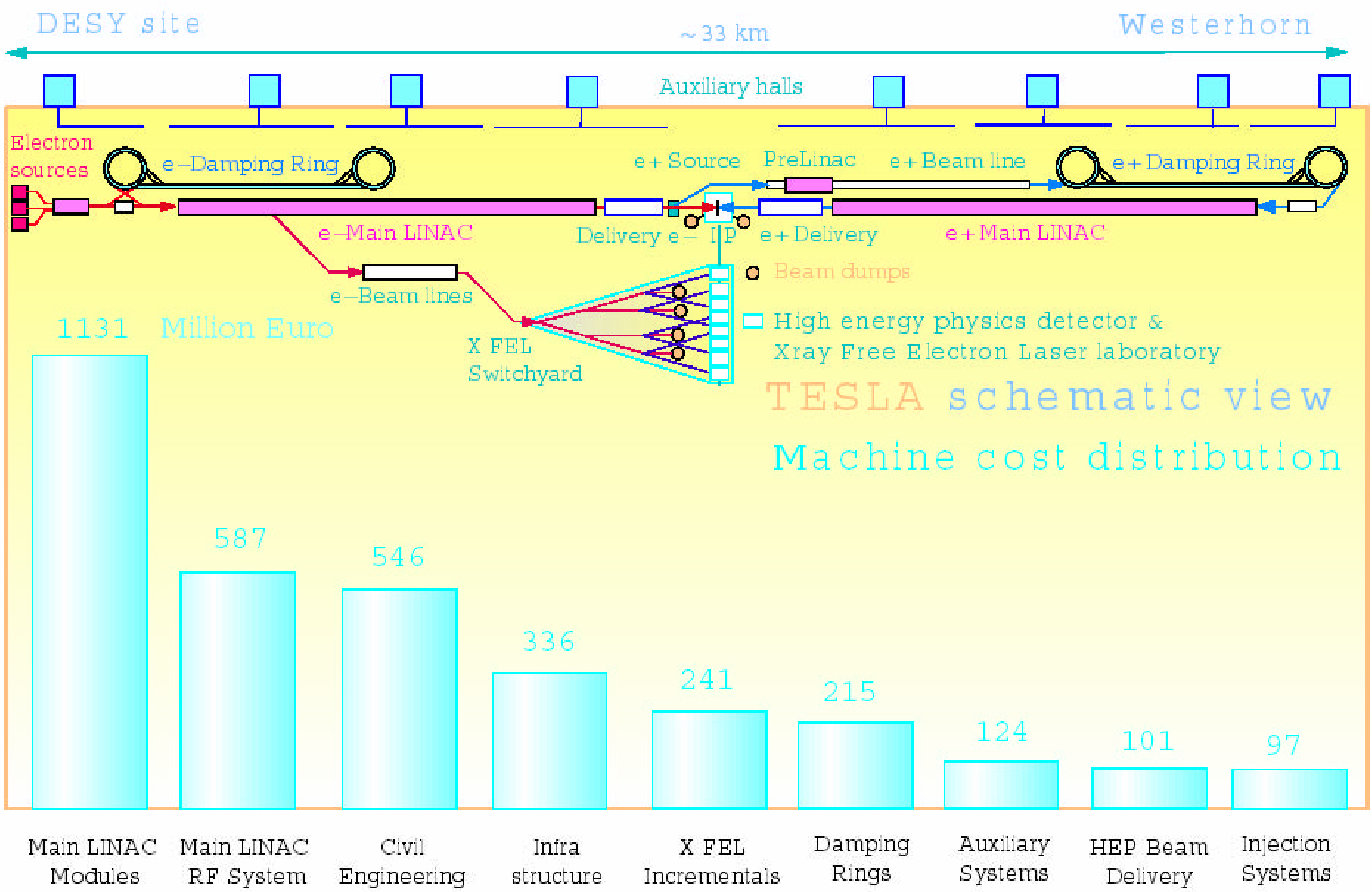
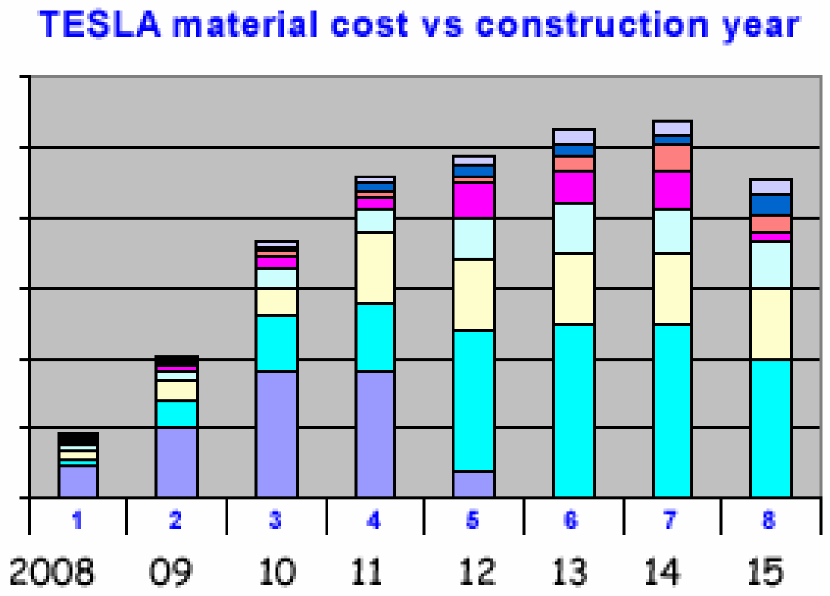


Figure 4.1.2: *Overview of the accelerator investment costs.*

3136 M€ for 500 GeV + 7000 person-year

An exercise.....

Spending Profile for TESLA



This is assuming a construction time of 8 years.

By parallel manufacturing of components this construction time can be shortened to ~ 6 years

-> matches turn on and first results of LHC before major spending starts

Asia

1€ ~ 136Y

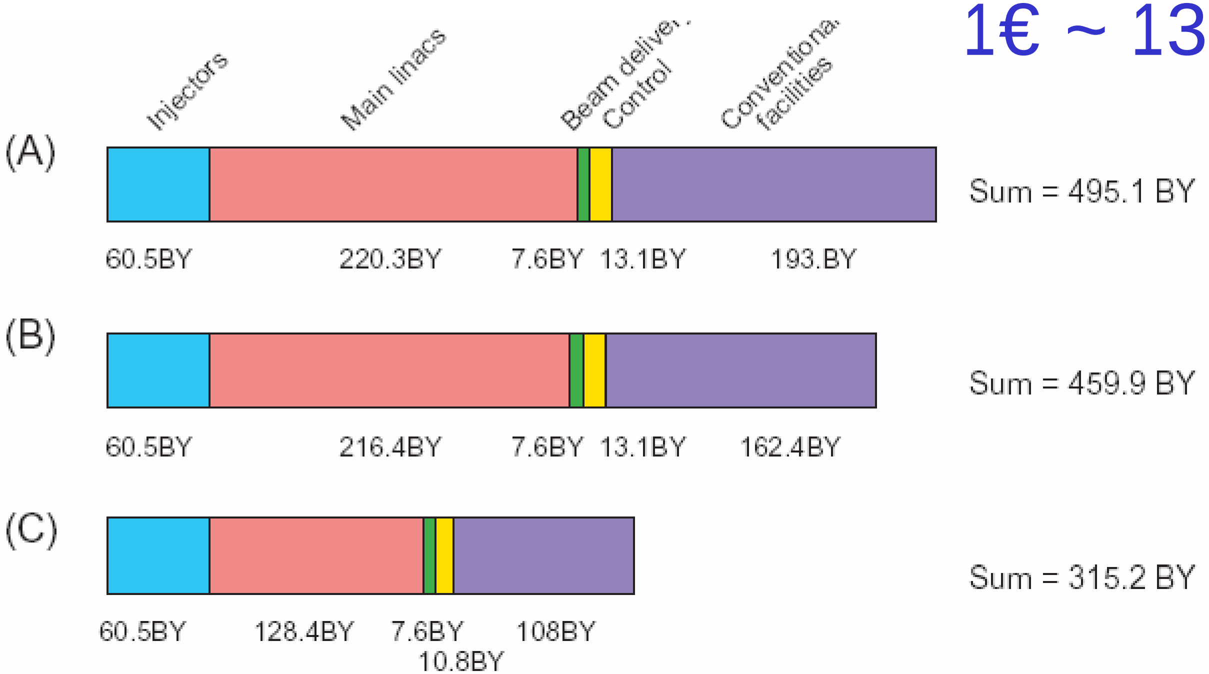
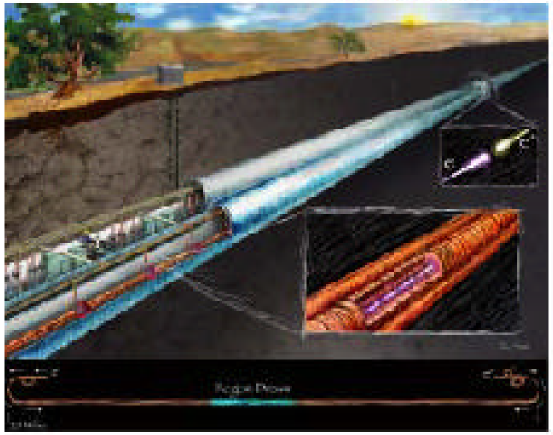


Figure 7.2: *Break-up of the construction cost for JLC into injectors, main linacs, beam delivery, controls and conventional facilities. The numbers shown are in the unit of Billion Yen (10 Oku Yen). (A) Baseline case, where the main linacs to support operation at $E_{CM} = 500$ GeV are built within long tunnels which can eventually support $E_{CM} = 1$ TeV operation. (B) Reference case, where the main linacs to support only up to $E_{CM} = 500$ GeV are built within short tunnels. which cannot be extended for $E_{CM} = 1$ TeV operation unless additional civil construction work is done. (C) Another reference case, where the main linacs to support operation only up to $E_{CM} = 300$ GeV are built within even shorter tunnels.*

Mid-Term Priorities

1st priority of Mid-Term

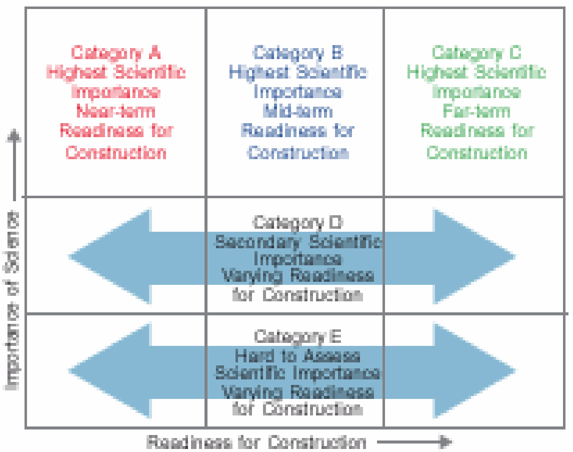
Priority: 13
Linear Collider



The Linear Collider is designed to extend the study of particle physics.

The Facility: The Linear Collider will allow physicists to make the world's most precise measurements of nature's most fundamental particles and forces at energies comparable to those of the Large Hadron Collider (LHC) now under construction in Switzerland.

Background: The Standard Model of particle physics, developed over the last 50 years and recognized as one of *the* great scientific achievements, has been tremendously effective in predicting the behavior of all the interactions of subatomic particles except those due to gravity, and in describing the varieties of particles that combine to make everyday matter. The next step—incorporating a theory of gravity and understanding why fundamental particles have mass—will require particle accelerators that function at the trillion-electron volt ("TeV") level.



Office of Science Facilities Matrix

What has happened?

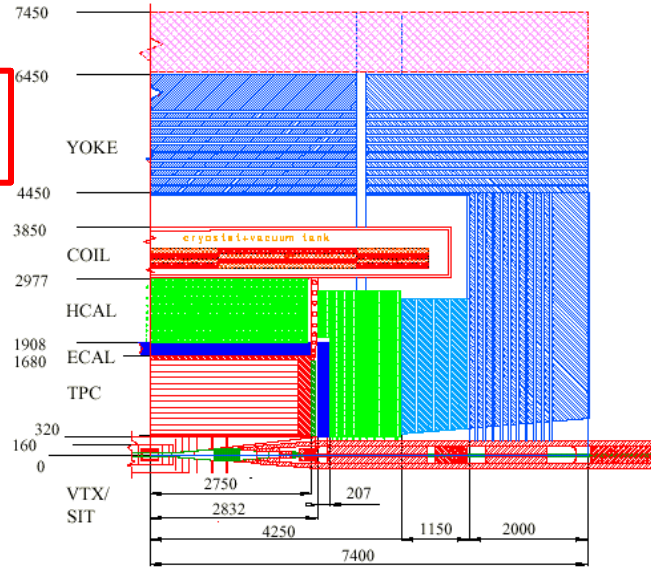
- Whole Detector Concepts

ILCSC

1. TESLA TDR
(N.A. “Large” similar)

Probably the most studied design (1, 8). Rethink now starting.

Now has 4 T field
TPC tracker
CCD microvertex
Cal’rs inside 3m i.r. coil
SiW ECAL
Hermetic to 5 mr
Coil length 9.2m (c.f. CMS)



D. Miller Detector issues 12/02/2004 ILCSC

3 concepts of Detector

Towards a Global DS

3 years R&D effort

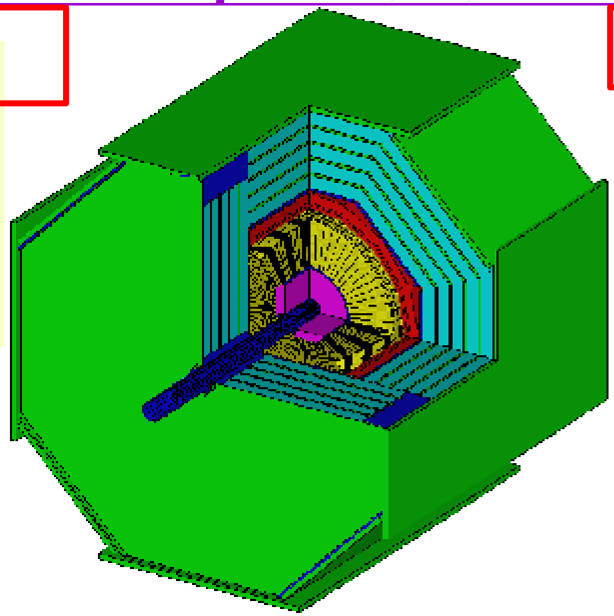
Whole Detector Concepts

ILCSC

2. GLC Detector (3)

Evolving from earlier JLC design.

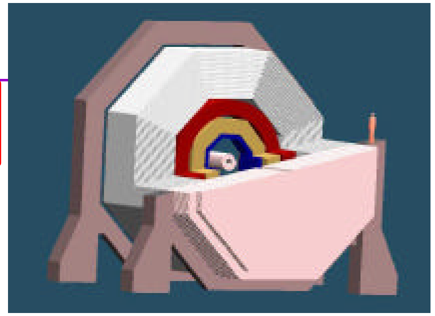
New 3 Tesla version
Jet-chamber tracker
Pb/scint ECAL+HCAL
inside 3.75m i.r. coil
Coil length 6.8m

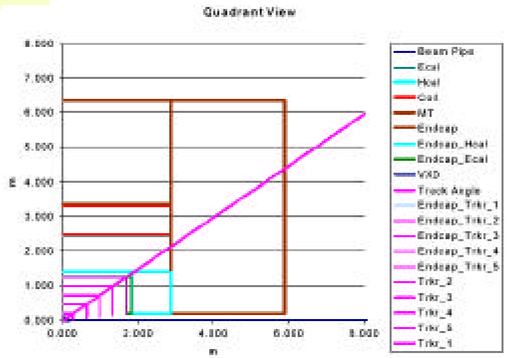


Whole Detector Concepts

3. North American SiD (4, 5, 6)

Always 5T
All silicon tracking; CCD + 5 layers of strips
Calorimeters inside 2.5m i.r. coil
Coil length 6m.
SiW ECAL





R&D programmes

(taken from WWS R&D website. http://blueox.uoregon.edu/~lc/randd.html
list incomplete – due for updates)

WWS keeping them in touch, encouraging co-operation between regions.

VERTEX DETECTOR

CCD
KEK-led collaboration
LCFI collaboration UK
Oregon/Yale Collaboration
Monolithic APS
Strasbourg-led collaboration
RAL-led collaboration
Hybrid APS
European collaboration
DEPFET
Bonn/MPI Group

MAIN TRACKER

TPC
Aachen, LBNL, MIT, DESY/U.Hamburg
Carleton/Montreal/Victoria, CERN
Orsay, Saclay, Wayne State, MPI-Munich,
Japan

Silicon
LPNE Paris, Santa Cruz, UCSC, Michigan,
Wayne State, SLAC, Asian groups

Jet Chamber
Asia

R&D programmes

(continued; *partial list*)

ILCSC

CALORIMETRY

SiW ECAL (+ HCAL)
CALICE, 28 Labs from 8 countries, including Europe, US, Canada and Korea.
SiD, North America

Tiles etc.
Padova
KEK et al (GLC)

ALSO FORWARD DETECTORS
MUON DETECTORS
PARTICLE IDENTIFICATION
TRIGGER+DATA ACQUISITION
TEST BEAMS
GAMMA GAMMA DETECTOR
BEAMLINE INSTRUMENTATION

MOST R&D programmes are underfunded.

Not enough test beams available, especially with high energy hadrons.

How to get experiments on time?

Time	T=2015	Tasks
T – >10~11	Before 2005	Detector R&D
T – 10~11	2005~6	Test Beam I
T – 8~9	2006~7	•Detector Technology chosen. •Detector Development and design begins
T – 6	2009	Detector Construction begins Test Beam II (Calibration)
T	2015	LC and Detector ready

Dicussed at 12 Feb. '04 ILCSC meeting

Table from Jae Yu

http://www-conf.slac.stanford.edu/alcpg04/Plenary/Saturday/Session1/Yu_TestBeam.pdf

Getting experiments on time.

DRAFT ILCSC conclusions, in response to report and questions from **WWS**:

1. **To fit the timelines (see Jae's slides) we need well worked out experiment CDRs by the end of 2006. Hope for >1 concept backed by credible worldwide collaborations.**
2. **Peer review of projects is needed.**
3. **Intimate connections needed between detector developments and accelerator planners in GDO.**

Request from ILCSC to WWS –

At LCWS Paris, this April: propose how to organise the detector community to achieve 1, 2 and 3 above.

Conclusions

- Fast move towards completing a world LC proposal to allow for a concurrent running between LC and LHC
- No one can guarantee the issue but Europe should not miss this train
- It is proposed that CERN-Council be a major actor in the financing of Europe participation (cf Kalmus report to ECFA)
- I hope that Spain will continue and amplify its participation on machine, detector and physics aspects


International Conference on Linear Colliders
Colloque international sur les collisionneurs linéaires
LCWS 2004
Paris, April 19-23, 2004
http://polywww.in2p3.fr/LCWS2004
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S. Bertolucci (Frascati)
P. Binétruy (LPT Orsay)
R. Blandford (SLAC)
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B. Foster (Bristol)
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Photo Robert CAMERON