Part 3: Dysfunctional Root Systems of Trees

ROCKY MOUNTAIN CHAPTER – ISA
2013 CONFERENCE
SEPTEMBER 26
CHEYENNE, WY

Definition 1: Need to Know

- ***CRITICAL BASE-LINE INFORMATION***
- ***ENABLES UNDERSTANDING***
- ***ESSENTIAL FOR CRITICAL THINKING***
- ***BASIS OF PROBLEM-SOLVING***

“Needs to Know”

Photo: Ben Johnson

Definition 2: Should Know

- ***PART OF PROFESSIONAL DEVELOPMENT***
- ***BETTER MANAGEMENT SKILLS***
- ***BETTER DIAGNOSTIC SKILLS***
- ***THE "EXTRA STEP" INFORMATION***

“Should Know”

Definition 3: Nice to Know

- ***EXPLANATIONS FOR "UNCOMMONS"***
- ***DIAGNOSTIC TIPS***
- ***TREE SPECIFIC***
- ***ACTION SPECIFIC***

Okay, Nice to Know but…(not those "Roots")

“Nice to Know”…bad roots can be saved

Roots. Part One: Need to Know

- Origin
- Root Systems
- Sustenance
- Depth
- Spread

Origin of Roots: The Beginning of Normal Roots

The Seedling Root:
First Out of the Seed

Seedling Roots

Black Walnut: 2 months from seed germination

Seedling Roots

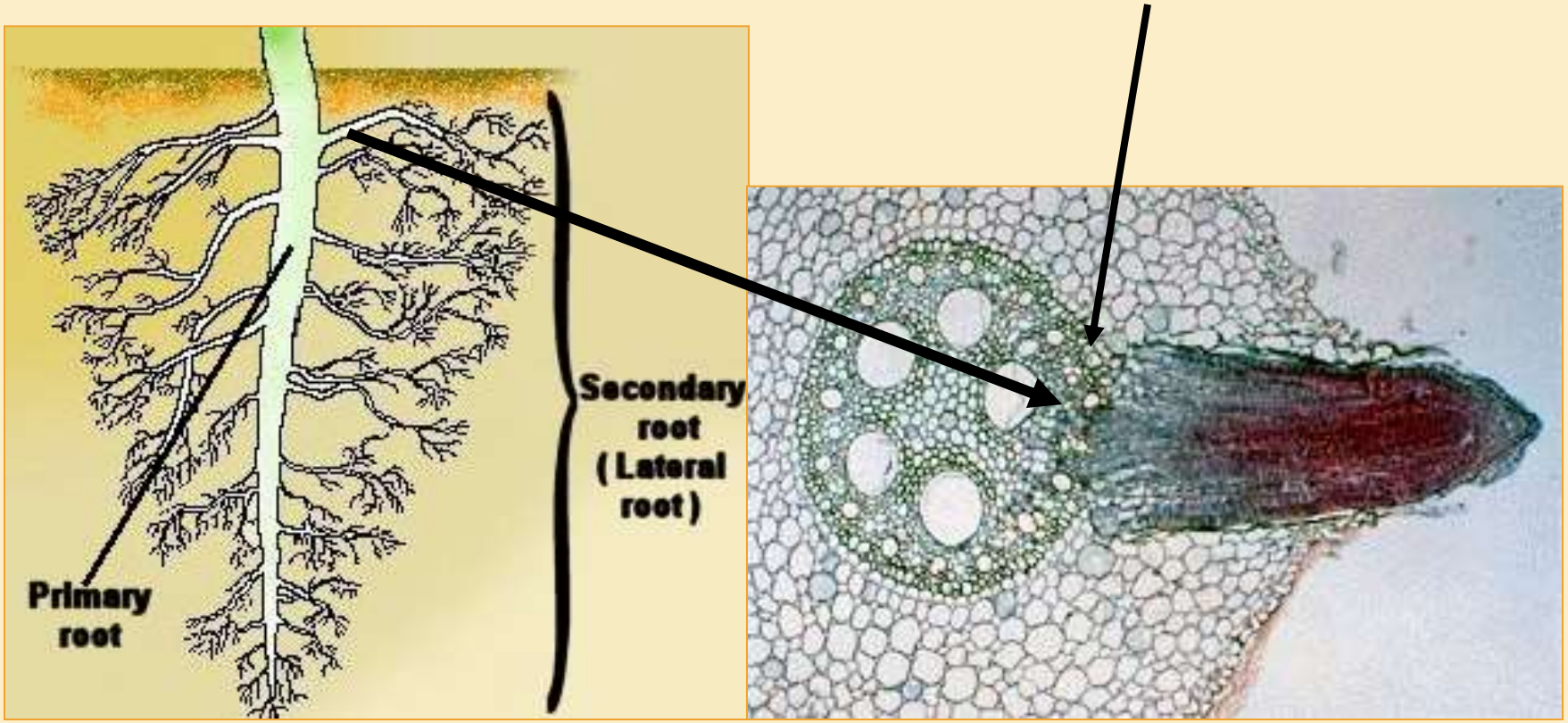
Amur Maple: 6 weeks from seed germination

Seedling Roots

White Walnut 5 months from seed germination

Branch Roots: Normal Developments

- Branch Roots Arise From the Pericycle



Origin of Roots: Adventitious Roots

Adventitious Roots

Different Root Systems

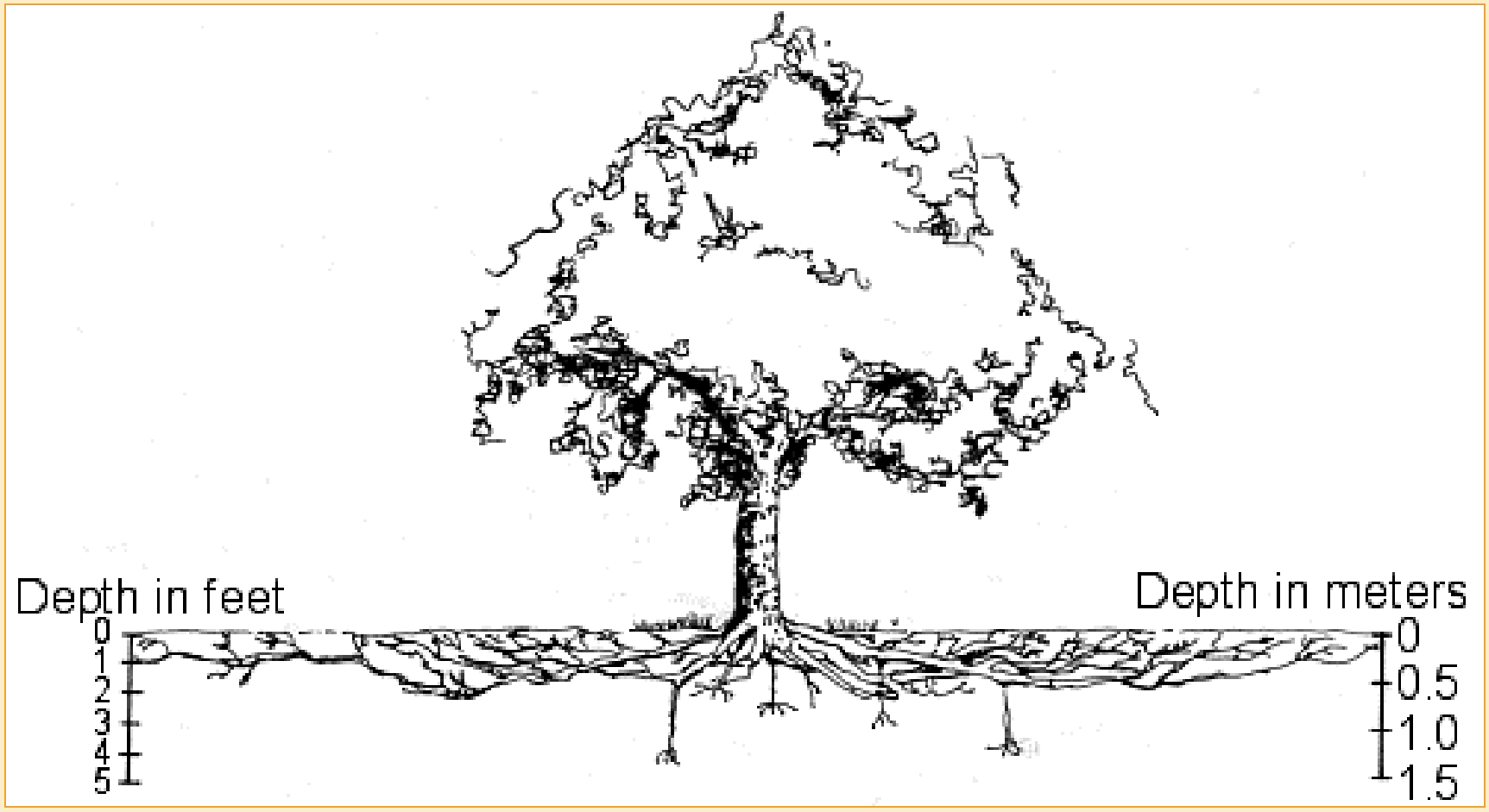
- Lateral Root Systems
- Heart Root Systems
- Tap Roots with Laterals

Categories of Normal Root Systems*

- Plate-root or lateral root systems – 82.5%
- Heart-root systems – 15%
- True tap-root systems w/laterals – 2.5%

*n = 4000 trees. Cutter, Gasson, Farmer, 1990. Arboricultural Journal

A Plate-Root/ Lateral Root System

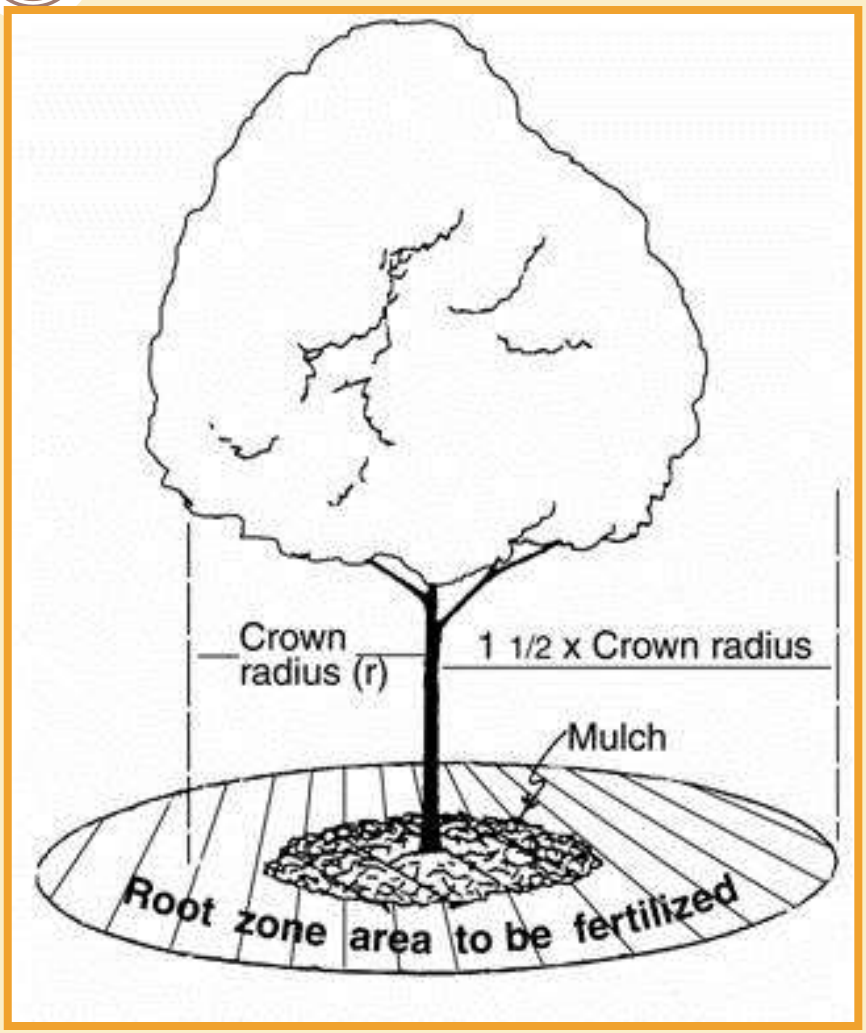


Heart-Root System

Tap-Root System with Laterals

Sustenance

- Carbohydrates
- Oxygen
- Water



Carbohydrates: Normal P.S., Normal Amount

Carbohydrates:Abnormal P.S. and Amount

Water and Oxygen

Water and Oxygen

Little Water and Oxygen

Root Depth

- Moisture
- Oxygen
- Ease of Penetration

Root Depth

Root Spread

- Genetics
- Soil Compaction
- Soil Water and Oxygen
- Obstructions

Root Spread

Honey Locust. Photo: K. Bachtell

Root Spread

More than 50% of roots are beyond the canopy

Root Spread Limitations

Roots. Part II: Should Know

- Mycorrhizal Roots (and relatives)
- Effects of Construction Damage
- Root Pruning vs. Root Damage

Mycorrhizal and Actinorhizal

- Mycorrhizae = Root + Fungus
- Mycorrhizae = Wide Host Range

Photo: Kew Botanic Gardens

Mycorrhizal Roots: A Fungus-Root Relationship in 90% of Trees

Photo: www.bugwood.org

Actinorhizal Roots

- Actinorhizal Root = Actinobacteria + Root
- Narrow Woody Host Range

Photo: University of CT

Actinorhizal Nodules on Alder

Roots: Mycorrhizal and Actinorhizal

- Mycorrhizal:
  - Nutrient and Water Efficiency
  - Protection from Pathogens/Insects
  - Limited Tolerance to Deicing Salts
- Actinorhizal:
  - Nitrogen Availability

Roots: Mycorrhizal and Actinorhizal.

- Both are Vulnerable to:
  - Soil pH Changes
  - Soluble Salts
  - Lack of Organic Matter
  - Lack of Moisture
  - Limited Carbohydrates
  - Pesticides

Construction Activities and Roots

- Physical Removal
- Changes in Rhizosphere

Construction and Roots: Physical Damage

- Instability
- Defensive Die back
- Lowered PS Potential

Construction and Roots: Defensive Die back

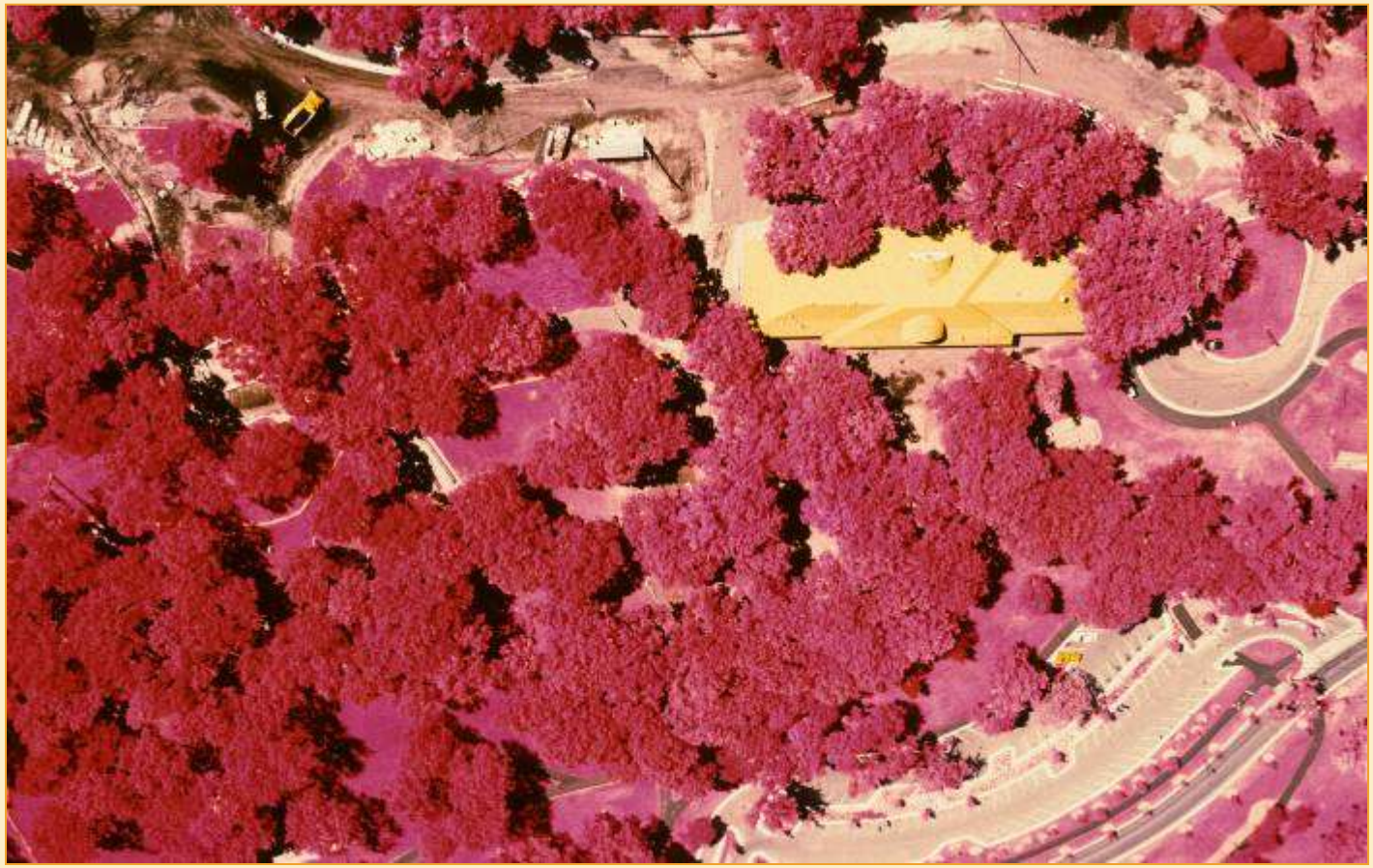
Construction Damage: Lowered PS Potential

Construction Damage: Changes in Rhizosphere

June 1997

August 1997

Monitoring: Aerial Photography CIR



September, 1997

Monitoring: Aerial Photography CIR

September, 1999

Root Pruning vs. Root Damage

Root Pruning vs. Root Damage

Root Pruning: Alternatives

Root Pruning: Alternatives

Roots. Part III: Nice to Know

- Correcting Problems
- Alternatives to Traditionals
- Roots Don’t Always Lose

Correcting Problems: Stem Girdling Roots

- #1 Reason for Storm Losses in Midwest*

Photo: E. Berg

Wind Loading Events and SGRs

- **As a percentage of all Total Tree Failures** in boulevards = **26.0%.**
- **Trees in the 6-10"** category that failed at compression points from stem girdling roots = **53%.**
- **The percentage of Littleleaf lindens** that failed at compression points from stem girdling roots = **68%**

Tree Failure and SGRs*

*Majority had 4+ inches of soil over first main order root

Tree Failure and SGRs

- Failure Threshhold was 50%+ Stem Circumference Compression

Buried Roots, SGRs and Decline

- Four (4) Randomized Species Surveys
- National Survey of Practitioners

•Stem Condition Declined*

•Canopy Condition Declined*

•Only Correlation was Soil Depth and SGRs

Buried Roots and Decline

SGRs and Decline*

*>80% of Cases in both surveys

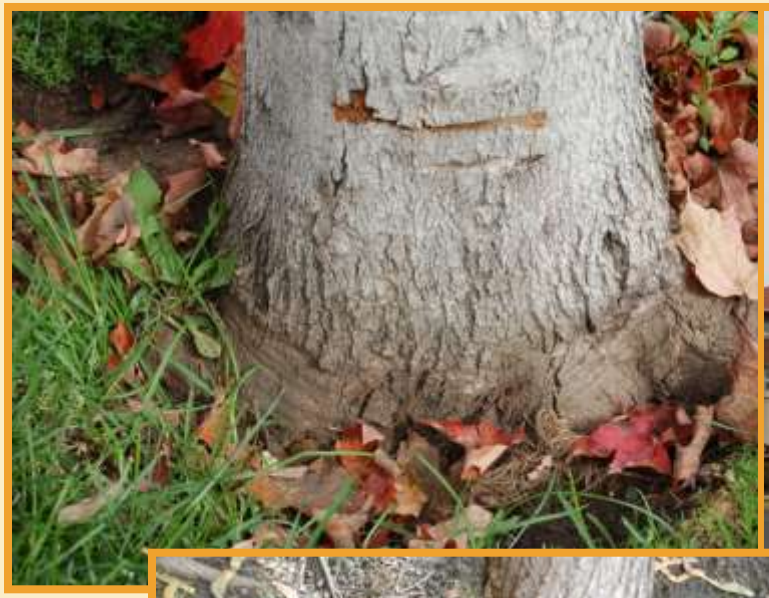
Photos: Ben Johnson

Recovering SGR and Depth Damage

- For SGRs, <50% Compression
- Species Specific
- For Depth, Condition Dependent

SGR and Depth Recovery

SGR and Depth Recovery: Maple



Buried Nursery Stock Roots

- Chronically, 4-6”+ Buried
- Containerized and B&B

Pot-Bound Root Systems

- Once Roots Become Woody, They Stay Woody

Pot-Bound Root Systems

- If Stems Are Buried, Encircling Roots Become SGRs

Pot-Bound Root System Correction

- “Boxing” Root Systems

Pot-Bound Root System Correction

- “Boxing” Root Systems vs “Scoring”

“Boxing” and Gravel Bed

“Boxing” and Gravel Bed

‘Fall Fiesta’ Sugar Maple, “boxed” and 12 weeks in Gravel Bed

Pot-Bound Root System Avoidance

- Air Pruning Pots
- Growing Bags

Air-Pruning Pots vs Conventional

Finally…The Gospel of Gravel*

*Coined by Chris Starbuck, U of MO

Gravel Bed Root Systems

Gravel Bed vs Soil Roots

- Soil: Early Roots Woody
- Gravel: Early Roots Fibrous

Fargo, ND's Gravel Bed Holds 250-400 Trees

Root Growth After 8 Weeks

Cercis canadensis

Prairie Horizon Alder

System is Irrigated

- Battery operated clocks
- Rain sensor to shut off system
- 4 - 180 degree heads
- 2 hr intervals (1-3 minutes) 6am-10pm

www.trees.umn.edu

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