

THE COMPLETE HISTORY OF THE UNIVERSE

$D=10$   
EXTRA DIMENSIONS?  
QUANTUM GRAVITY EPOCH  
 $t \approx 10^{-43}$  sec  
 $T \approx 10^{29}$  GeV

GUT EPOCH  
 $t \approx 10^{-34}$  sec  
 $T \approx 10^{16}$  GeV  
W-S/G/FINAL EPOCH  
 $t \approx 10^{-12}$  sec  
 $T \approx 10^3$  GeV  
QUARK ENSLAVEMENT

BIG BANG NUCLEOSYNTHESIS  
 $t \approx 10^{-2}$  sec  
 $T \approx 10^{-1}$  MeV  
DECOUPLING  
 $t \approx 10^{13}$  sec  
 $T \approx 1$  eV

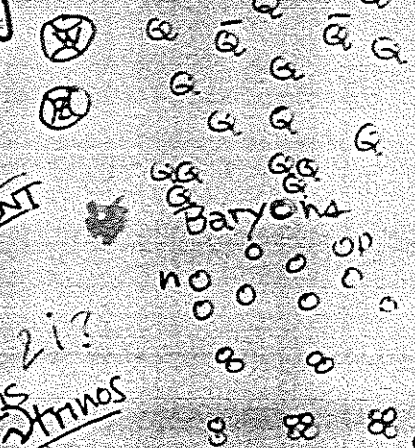


Quark-anti Quark asymmetry

MONOPOLES

homo- & genety isotropy Flatness OP/P

INFLATION



Baryons

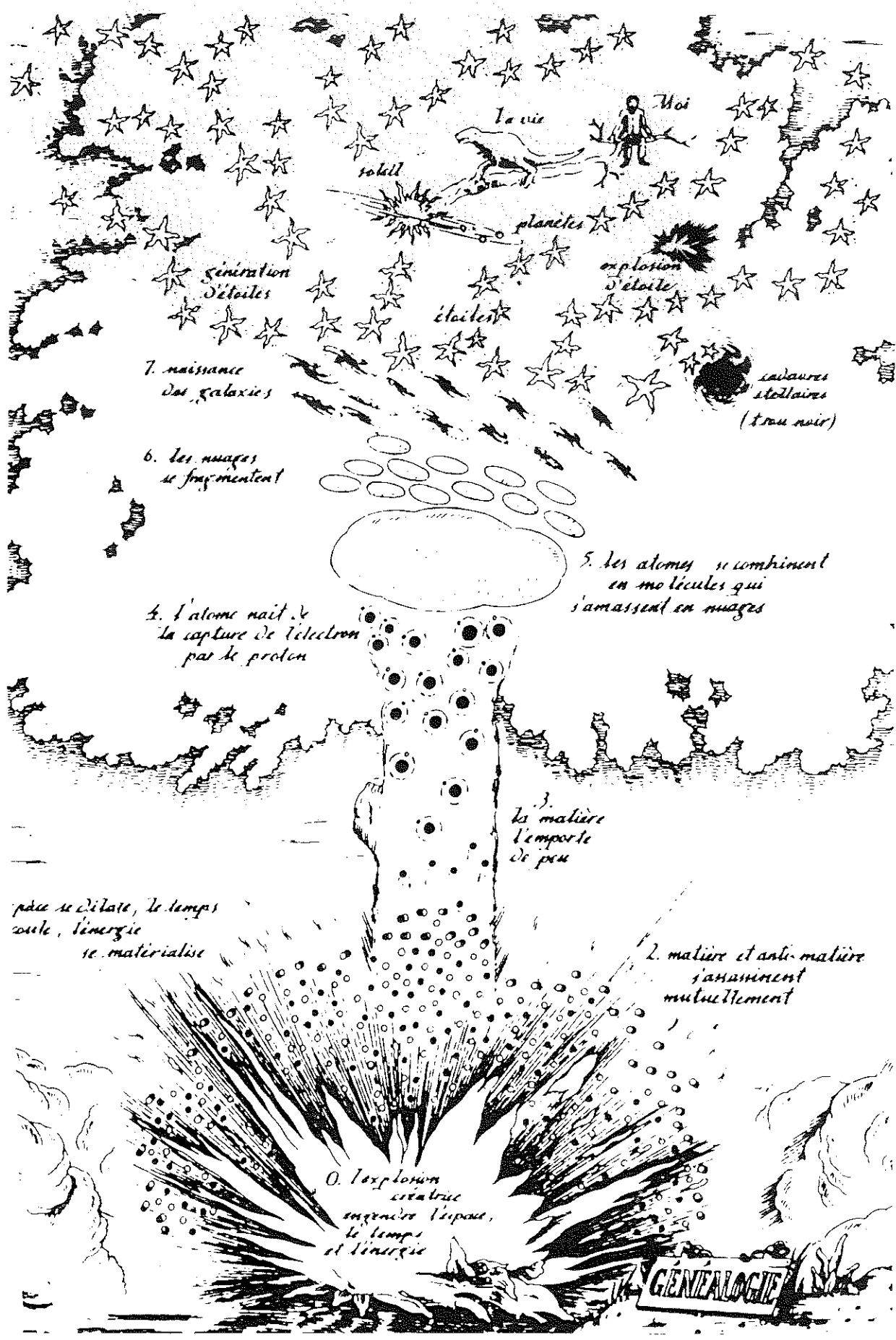
QUARK NUGGET

MATTER DOMINATION  
 $t \approx 10^{10}$  sec  
 $T \approx 10$  eV  
PLANCK strings?  
AXIONS?  $\nu$ inos?

Stanford, CA PBHs  
Fermilab QUARK NUGGETS  
SNOWMASS  
STUBBINS  
MAYMAY

particle? \*





7. naissance des galaxies

6. les nuages se fragmentent

4. l'atome naît à la capture de l'électron par le proton

5. les atomes se combinent en molécules qui s'accumulent en nuages

3. la matière l'emporte de peu

2. matière et anti-matière s'annihilent mutuellement

pace se dilate, le temps coule, l'énergie se matérialise

0. l'explosion créatrice engendre l'espace, le temps et l'énergie

GÉNÉALOGIE

## X Ray Apparatus

OF ALL KINDS.

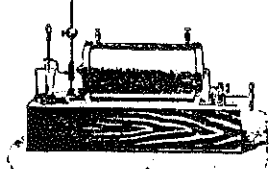
- (1) **RUHMKORFF COILS.** (Immersed in oil;—the highest insurance of insulation.)
- (2) **HOLTZ MACHINES.** (Latest type. Efficient, portable.)
- (3) **HIGH FREQUENCY SETS.** (For alternating currents. Designed by Prof. Elbbe Thomson.)
- (4) **CROOKES TUBES.**
  - (a) Double-focusing (Thomson Universal).
  - (b) Single-focusing.
  - (c) Globular.
  - (d) Elongated pear-shape.

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- (5) **FLUOROSCOPES.** (Approved patterns, various sizes.)
- (6) **FLUORESCENCE SCREENS.** (Even distribution, various sizes.)
- (7) **CALCIUM TUNGSTATE.** (Fine crystals, chemically pure.)

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 — (PHOTOGRAPHIE DE L'INVISIBLE) —  
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 Fabrique d'Appareils d'électricité médicale et industrielle. 18, cité Trévisse, PARIS  
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 livraison de 8 à 10 jours. — CHARGE DES ACCUMULATEURS A FORFAIT

FIG. 86c.

**MATÉRIEL COMPLET**  
 Pour répéter les expériences  
 DU  
**Professeur ROËNTGEN**

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**CORPS OPAQUES**



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FIG. 86d.

**LUIGI GORLA**  
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 Premiato alle Esposizioni di Medicina ed Igiene  
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apparecchi di elettro-medica  
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 Bobine **RUHMKORFF** da L. 600 - 520 - 350 - 230.  
 Tubi di **CROOKES** modello B L. 30 - modello C L. 25 - modello D L. 20.

L'Agenzia del Giornale **Il Policlinico**, Roma, Via Convertite, 8, assume commissioni per questa Ditta.

FIG. 86a.

**RAYONS X PHOTOGRAPHIE A TRAVERS les CORPS RAYONS X**  
**MATÉRIEL COMPLET**  
 BOBINES **RUHMKORFF** - TUBES DE **CROOKES**  
 CHEZ **RADIGUET** 15, Bd des Filles-du-Calvaire  
 PARIS  
 PAS DE SUCCURSALE

FIG. 86b.

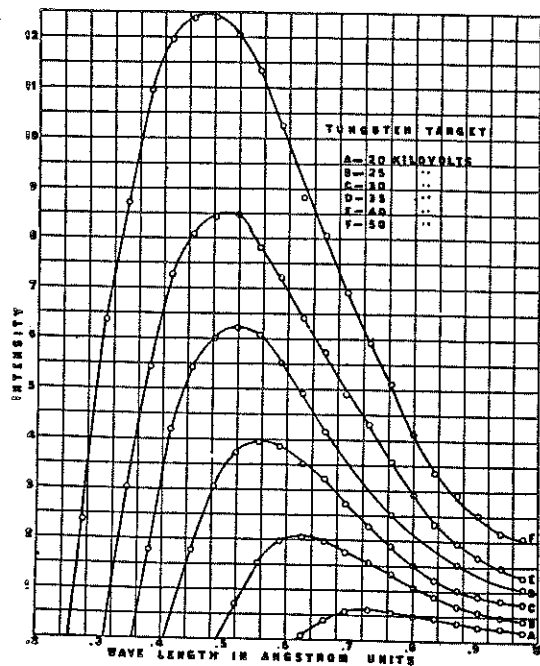


FIG. I-30. Continuous X-ray Spectra at Different Constant Potentials. (Ulrey.)

Duane & Hunt

$$Ve = h\nu_{\max}$$

Einstein's photoelectric

$$\frac{1}{2}mv^2 = h\nu - w$$

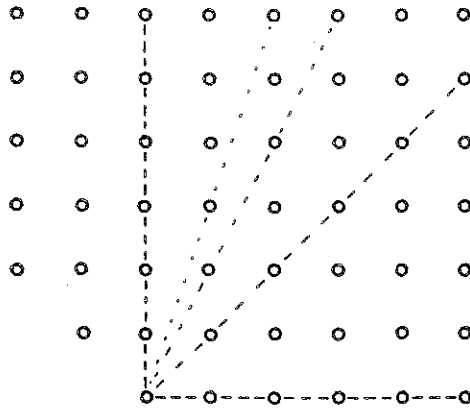


FIG. I-22. A Two-dimensional Point Array. The linear density of points is especially large along the dotted lines.

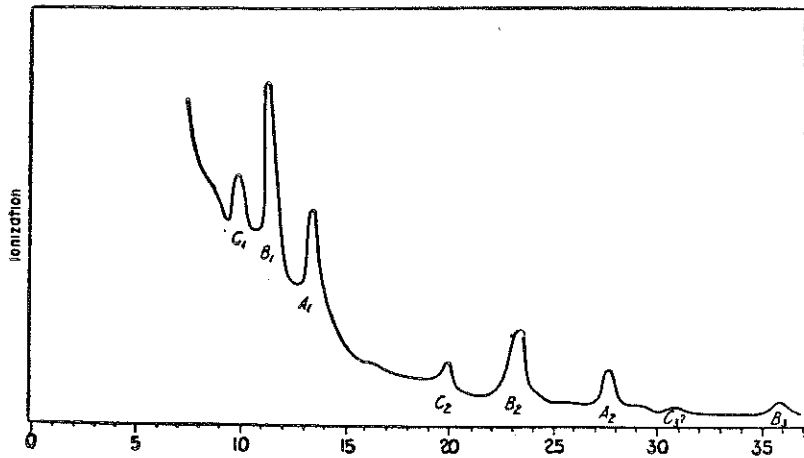


FIG. I-24. The First X-ray Spectrum. (W. H. Bragg.)

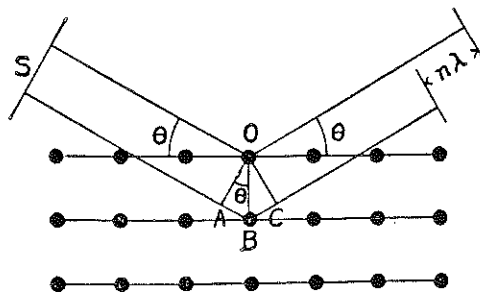


FIG. I-25. Illustrating the Elementary Derivation of the Bragg Law.

Bragg's Law

$$n \lambda = 2d \sin \theta$$

$$d = \overline{OB}$$

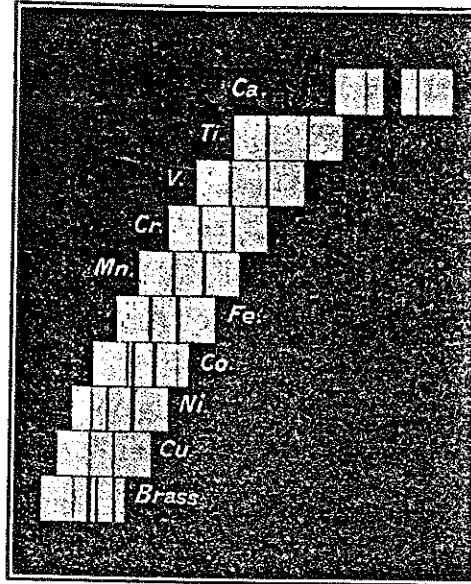


FIG. I-27. Typical K series Spectra. (Moseley.)

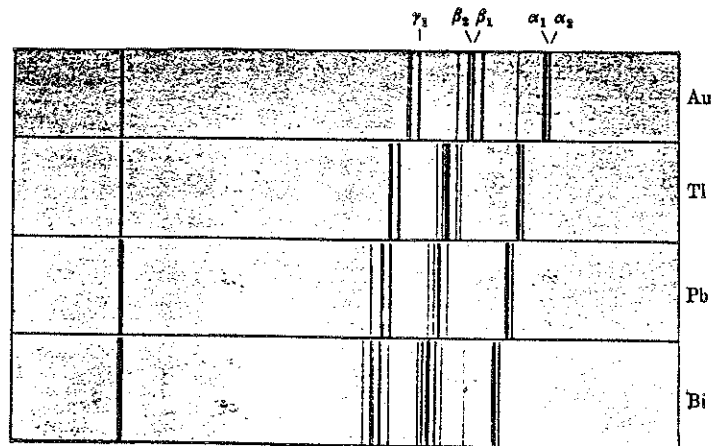


FIG. I-28. Typical L Series Spectra. (Siegbahn.)

Moseley's Law

$$\nu^{\frac{1}{2}} = K(z - \sigma)$$



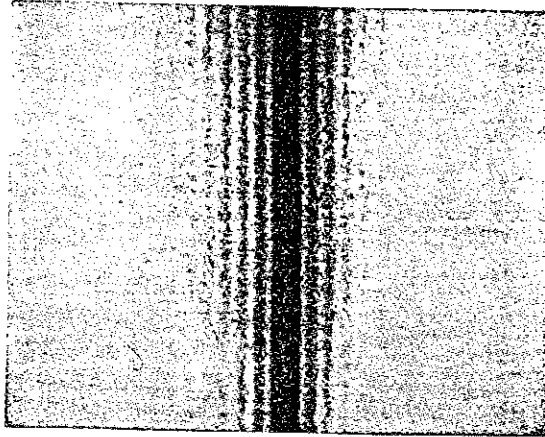


FIG. I-14. Enlargement of Diffraction Pattern of 8.3 A. X-rays Traversing 0.0055 mm Slit. (Larsson.)

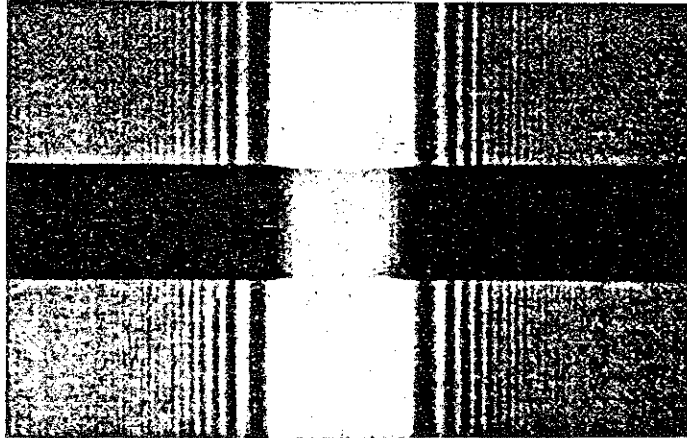
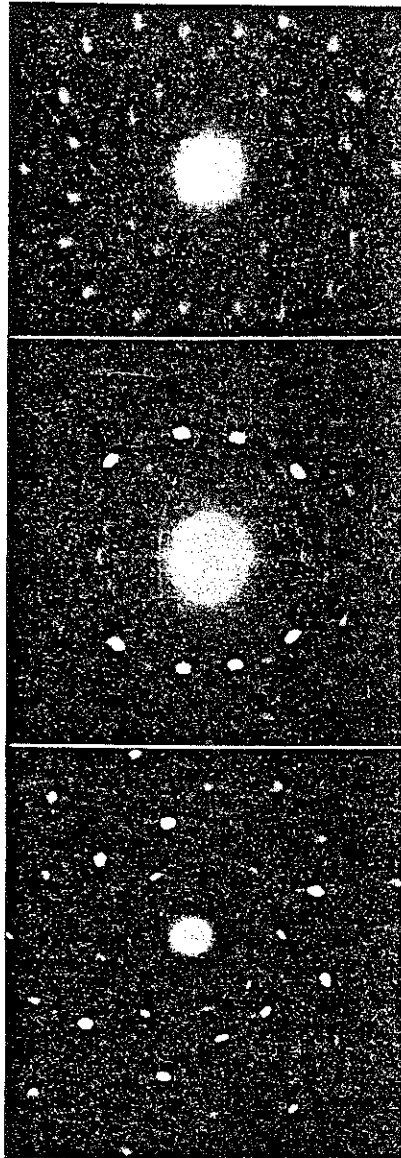


FIG. I-15. Diffraction of 8.3 A. X-rays by 0.038 mm Wire, Enlarged 73 Times. Middle portion printed darker. (Kellström.)



A. X-rays perpendicular to  
cube face (100 plane).

B. X-rays perpendicular to  
cube edge (110 plane).

C. X-rays along cube diagonal  
(111 plane).

FIG. I-21. Laue Diffraction Patterns with Rock-salt.

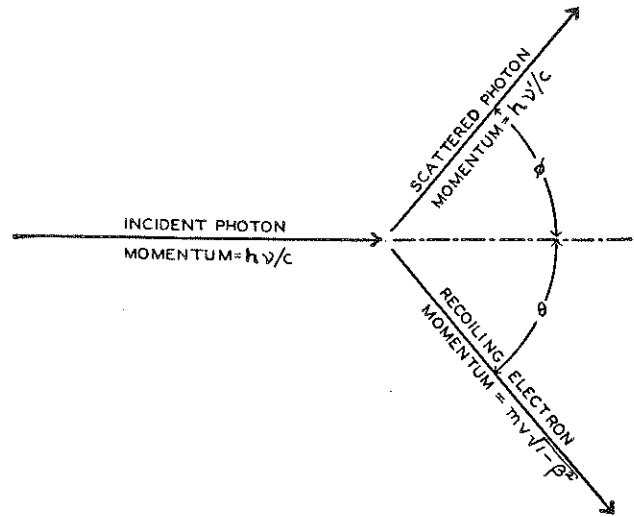


FIG. III-47. When an x-ray photon is scattered by an electron at an angle  $\phi$ , the electron recoils at an angle  $\theta$ , using some of the photon's energy and hence reducing its frequency.

$$\lambda' = \lambda + \frac{h}{mc} (1 - \cos \phi)$$

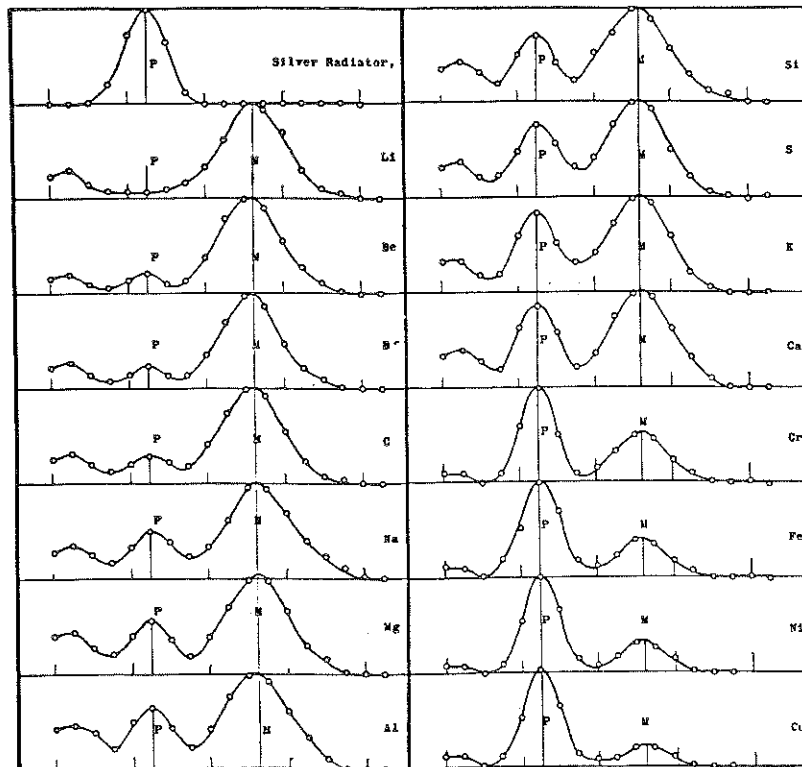


FIG. III-48. Spectra of silver  $K\alpha$  line scattered by different elements, showing the increase in prominence of the unmodified line with increasing atomic number. (Woo.)

*Conservation of momentum as well as energy*