The problem is this. Ox, oy, oz (ox<oy<oz) are the three semi-axes of an ellipsoid (with its centre at O); OM and OM' are the normals respectively to the two central circular sections of the ellipsoid [Prof Darwin, whom I consulted about the naming of these central O^rs sections, suggested the name 'umbilic' or 'umbilicus'.]. The ∠^le between OM and OM' = 2V, OZ being the bisector of 2V (and Ox of π−2V). Now consider any central section (ellipse) of the ellipsoid. Let Oξ and Oη be the two semi-axes of the ellipse — it is supposed that we do not know which of them is the major ax. and which minor — and let ON be the normal to the section. Then we have the following results:-

(1) The pair of planes ξON and ηON are the two bisectors of the planes MON and M'ON.

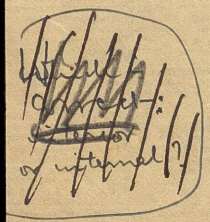
2) $$\tan^2 V = \frac{oz^2}{ox^2} \cdot \frac{oy^2 - ox^2}{oz^2 - oy^2} \cdot \left[= \frac{\frac{1}{ox^2} - \frac{1}{oy^2}}{\frac{1}{oy^2} - \frac{1}{oz^2}} \right]$$

Consider a set of coordinate axes having O as origin; with reference to these axes the orientations of the axes of the ellipsoid (or of OM, OM') are not known.

The problem is to find the directions of OM and OM' from the following data. For n different sections (i.e. sections whose normals, viz. ON_1, ON_2 -- ON_n, are given with reference to our axes) the directions of the axes $O\xi_1$, $O\eta_1$; $O\xi_2$, $O\eta_2$; ---; $O\xi_n$, $O\eta_n$ are known. (A) What should be the value of n necessary for a unique determination of the directions of OM and OM'? It has been proved to be 4, by Hilton geometrically, and by Weber and another analytically (B) They have further developed methods, geometrical and analytical respectively, for determining the directions of OM and OM' from data for the directions of

$O\xi$ and $O\eta$ for 4 different given sections.

If further for one of the sections we know which is the major axis, $O\xi$ or $O\eta$, we know in addition whether $2V$, which OZ bisects, is acute or obtuse, i.e. whether OZ is the internal bisector or the exterior bisector of the $\angle$ between OM and OM'. [A similar knowledge relating to the sign of $O\xi - O\eta$ for the other 3 sections does not give us any additional information].



Now if the ellipsoid is nearly a sphere, i.e. if $\frac{OZ-Ox}{Ox}$ is very small, ~~the expression for~~ we have the simple further relation

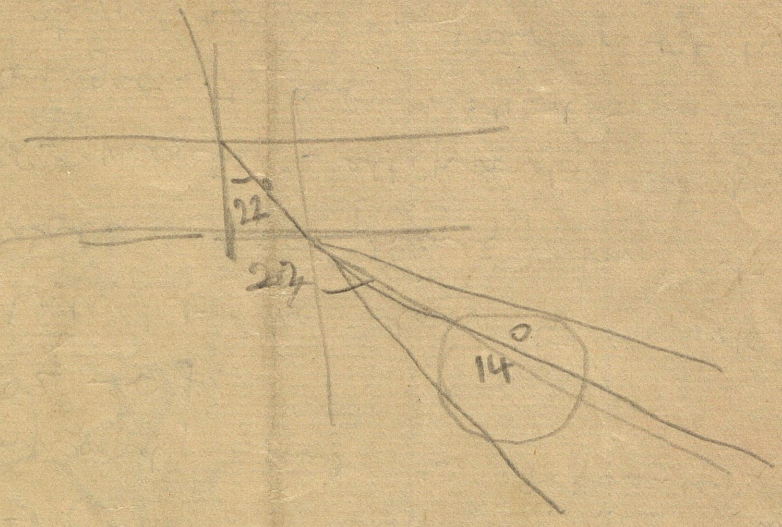
$$|O\xi_1 - O\eta_1| = (OZ-Ox)\sin\theta_1 \sin\theta_1'$$

where θ_1 and θ_1' are the $\angle$les between ON_1 and OM_1, and ON_1 and OM_1' respy; and similar relations for the other sections.

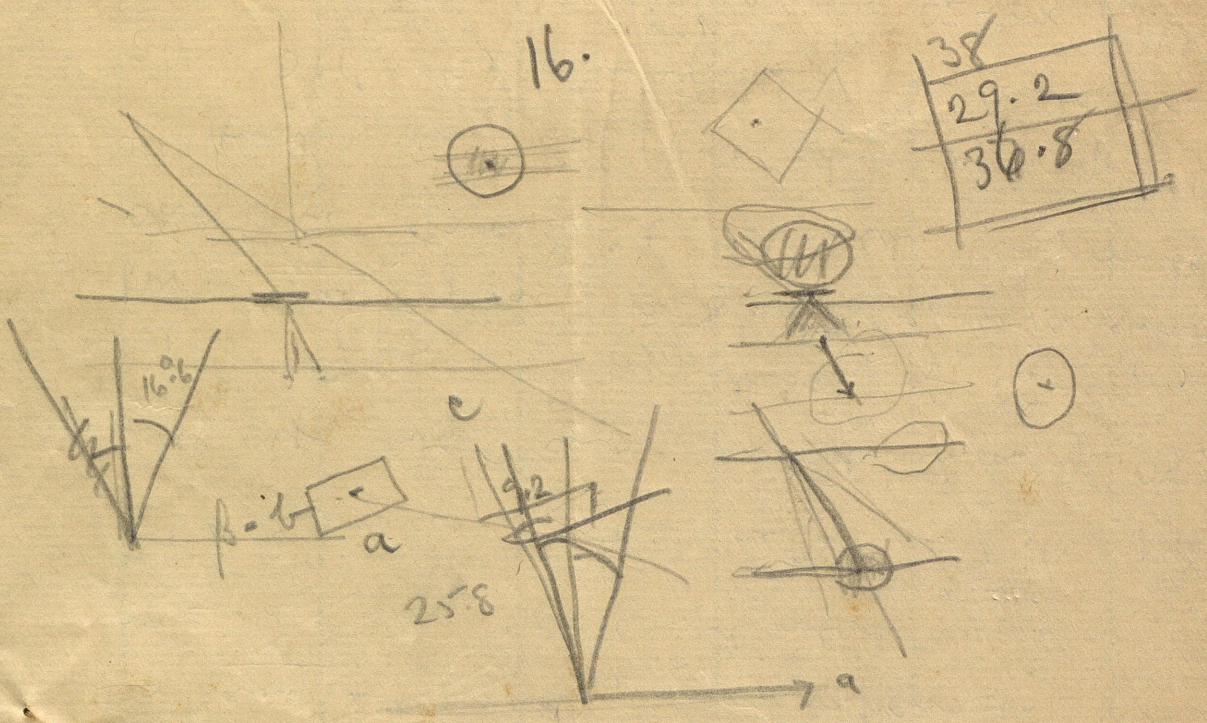
For <u>any</u> ellipsoid, the expression for $O\xi - O\eta$ will be complicated.

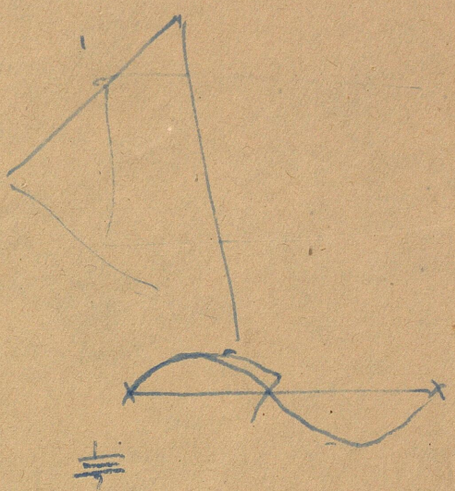
In view of this relation for $O\xi - O\eta$ it appears that if we know the direction of $O\xi \pm$ $O\eta$, and the magnitude + signs of $O\xi - O\eta$, for <u>three</u> (not 4) given sections (i.e. the corresponding directions of the ON's are given) it should be possible to find uniquely (1) the directions of OM and OM' (2) whether 2V is acute or obtuse (3) the value of $OZ - OX$ and $\therefore$ of $OZ - OY$. In other words we shd be able to find (the separated) three axes OX, OY, OZ (smallest, intermediate + largest) of the ellipsoid, and the differences between the axes; $OZ - OX$ and $OZ - OY$.

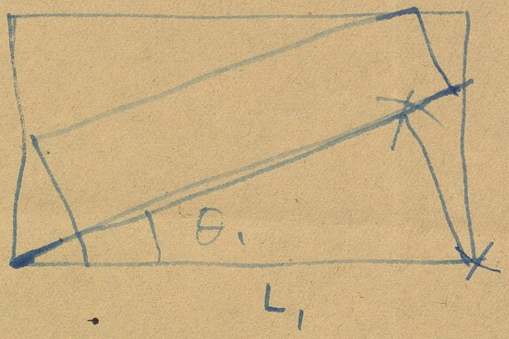
Will it be easy to work out the problem analytically, for at least the nearly-spherical-ellipsoid; or find a suitable geometrical method, making use of the stereographic or other projection, if convenient, to solve the problem?—



16.







Just as in a piano wire vibrating, only certain discrete wave-lengths are maintained, $\lambda/2 = L, L/2, L/3,$ i.e. for which ends pts are nodes. Similarly in an enclosure only those for which the bounding walls are nodal surfaces.

Complicated when the walls have any shape.

- Rect. parall

$$L_1 \cos\theta_1 = n_1 \frac{\lambda}{2}$$

$$\sum \cos^2\theta_1 = \frac{\lambda^2}{4}\left(\frac{n_1^2}{L_1^2} + \frac{n_2^2}{L_2^2} + \frac{n_3^2}{L_3^2}\right)$$

~~k_x^2~~

$k_x = \frac{n_1}{2L_1}$, $k_y =$

$$K^2 = \frac{n_1^2}{4L_1^2} + \cdots$$

The no of K cells included in the region from $K = 0$ to $K = K_0$

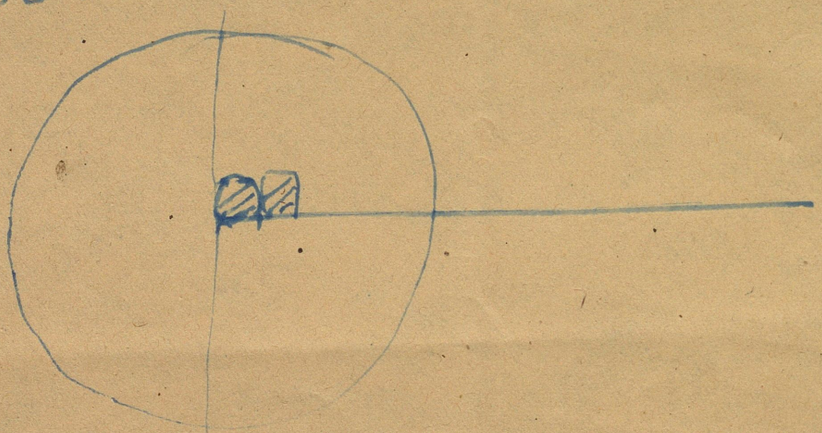
= Vol. of an octant of the ellipsoid whose semi axes are $2L_1 K_0, \cdots$

$$= \frac{1}{8} \times \frac{4\pi}{3} \times 8 L_1 L_2 L_3 K_0^3$$

$$= \frac{4\pi}{3} K_0^3 V$$

As though no vol. enters in calculation

The no of K states per unit vol. of the medium between K and $K + \Delta K = 4\pi K^2 \Delta K$.



It is as though as though, per unit vol. of the medium each cell in K space had a vol. unity taking negative values of K also in accordance

Oscillations of a drumhead; ~~in a~~ acoustic waves in a rectangular chamber, and in calculating energy distribution in black body radiation.

Used now in wave-guides.

electron

Division of phase space into cells ∴ Each of vol h^3 on the same basis.

Br. Zones: Simple cubic

$\frac{1}{2a}$ Vol. $= \frac{1}{8} a^3$.

~~Each unit vol. in space corresponds to~~ ~~1 cc.~~ The no. of atoms ~~per unit vol.~~ that can

The no of atoms per unit vol. $= n = \frac{1}{a^3}$. Also ∴ one cell to atom.

ii (110) ~~+ (100)~~ $2/a^3$

iii 111 + 200 $4/a^3$

Body centred

100 absent-

110 first- cell. Vol. $\frac{2}{a^3}$.

The no per unit vol. $= \frac{2}{a^3}$.

$a^3 = 2$

Face centred- Cube

100 & 110 do not occur

111 + 200 $4/a^3$.

Significance of unit Bar zone.

Diamond:

22

Solids : Regular : 5

Platonic ~~Laws~~ All faces same regular polygons. ~~All edges = angles~~

. All faces identical
. Corners "

Inversion

All faces regular and same regular corners identical

14

Absorption 3

~~Shift~~ Polarizati as affecting absorption frequ

Solns * ~ | Exptal various methods [illegible]

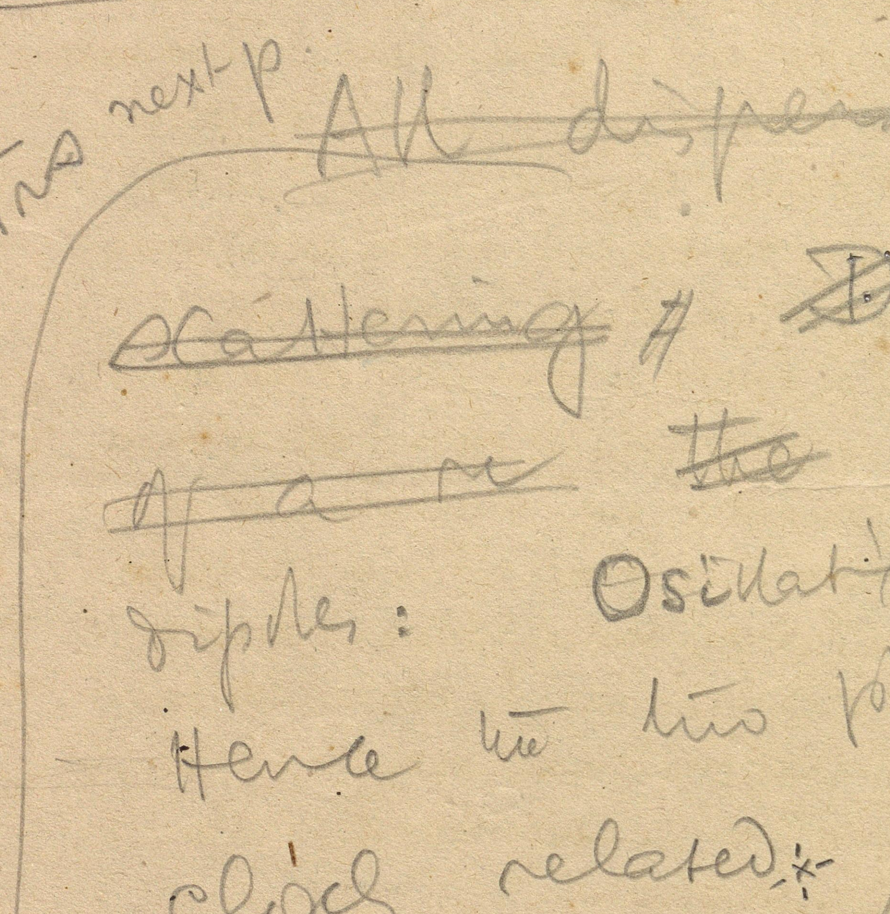
Trs next p. ~~All dispersion due to scattering~~ # ~~D. The occur~~

~~of a m~~ ~~the~~ Dispersion

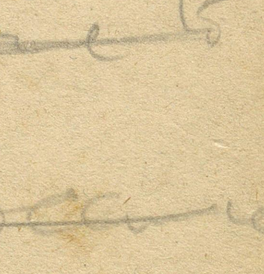
dipoles: Oscillati dipoles scatter.

Hence the two phenomena very closely related.* ~~Hence~~. Isotropic

$\frac{1}{\mu - 1}$ molecules



~~μd~~ "1"



Expression for

$(\mu-1)t = n\lambda =$

Group vel:

 (APPENDIX III)

In the U.S.A. "A bachelor's degree in science or engineering is prescribed as qualification for appointment to a position of at the sixth step of grade GS-5 ($ 4,035 a year). Additional education or experience is necessary to qualify for appointment at grades above GS-5...." We may recommend B.Sc.(Hon.) as the equivalent starting level and which is fairly close to M.Sc. While we cannot readily convert the equivalent starting pay from dollars to rupees by the use of exchange value, we can place the starting pay of a qualified scientist in relation to the top of scale. In the 15-step American pay-system the maximum annual basic pay is about $ 12,000 (minimum $ 3,000). Thus the starting pay of $ 4,000 is about 1/3rd of the top of scale. If, in our system, the top of scale is taken at (average) Rs. 2,500/- p.m., the starting pay of a qualified scientist is to turn out at Rs. 800/- p.m. A fresh M.Sc., in this country would feel lucky to get a start of Rs. 250/- p.m., and one with 3-4 years of specialized experience may be given a start of Rs. 350/- in the Grade II Senior Scientific Officer in the scale of Rs. 350-850.

Under the present rules, a person cannot normally transcend his prescribed grade to which he is originally recruited. He cannot go up even if he proves himself qualified for better responsibility and higher post. He cannot go beyond the top of his grade when he reaches the top of his own scale.

If the scientific talents are to be drawn and retained, it appears that

(i) that starting pay has to be increased and

(ii) merit promotion system has to be made easy enough.

....4

Scattering Isotropic molecules

1. Einstein's = $\left(\frac{\partial n}{\partial \rho}\right)$

(a) Usual method in terms of fluctuations 1. Either all of the no in ~~same phase~~ random phase instantaneously add up as in a gas =

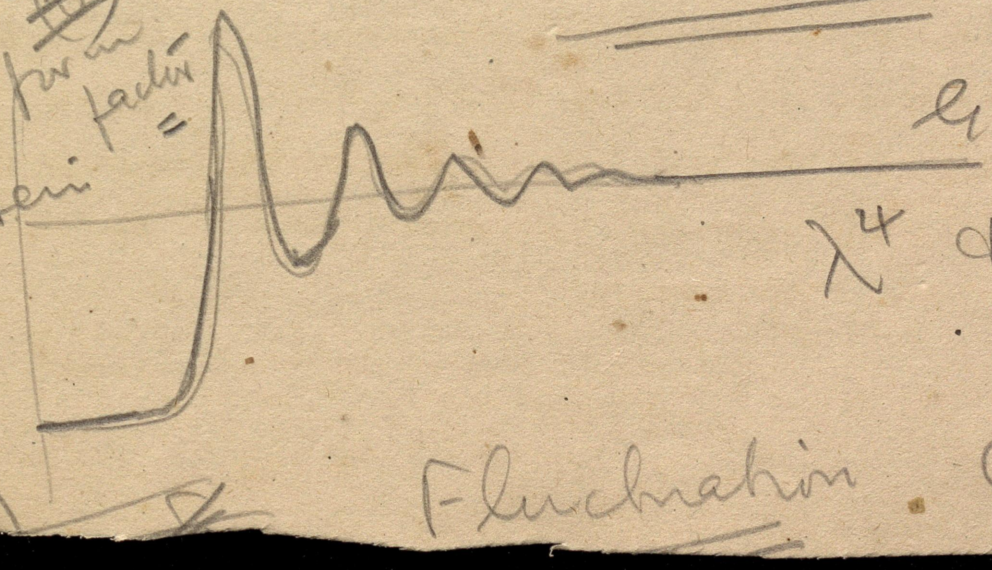
~~at I.~~

~~appli~~ Lorentz's

~~If $\varphi/2$ is small~~ θ is small

Forward direction

atomic form factor = Einstein =



Gas Ray

λ^4 & independent of λ

Fluctuation can be

APPENDIX III

A note on pay scales and job openings for scientific personnel

From the review of the pay scales adopted in the scientific services of the Government one would, on the surface, find that the scales cover a very wide range going upto Rs. 2,000 per month or more (say, Rs. 2,500/-) at the top and covering all the intermediate grades like any other administrative or other services. Under our present system or by the Pay Commission's recommendation, the ceiling is practically the same for Scientific, Administrative and Engineering services.

It would, therefore, superficially appear that the scientists, engineers and technologists do not have much ground for grievance regarding the pay scales fixed for them, unless it is desired to make scientific and technical services more attractive than administrative posts as in the U.S.A., and U.S.S.R. (Reference: A note on Scientific Services, Appendix I, presented in the 2nd Meeting of the Scientific Personnel Committee on 10.12.1956, paras 16, 18).

The picture of grades as mentioned above (see the pay-scales on Page No. 2) is however far from complete. Such grades for the scientific, technical and engineering personnel are available to an extremely small fraction of the qualified candidates in the country. In more than 90 percent, perhaps, of the scientific services, including those in the research and educational institutions, the pay scales are very low. The low starting pay, long-drawn-out time scale, and the lack of the provision for merit-lift discourage many potentials of the scientific talents of the country.

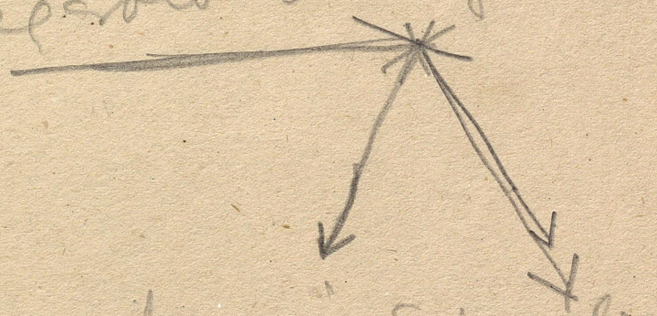
.....2

treated in a different manner: as done by Emden many significant results can be obtained this way.

$\frac{\sin^2 n\zeta}{\quad}$ × ×

Now significant if all of them are close to 0. can be regarded as reflection.

Bohr application of Bragg



Brillouin:

In which are impressed ultrasonic waves.

Only 2

more with longer wavelengths.

[illegible] in X-region.

personnel problems. More points may be added in due course, if necessary.

As it is, each point entails a number of specific studies, and the detailed programme will have to be worked out for the working units and the study groups.

A large amount of basic data can be drawn from the existing records, such as publications of the different Ministries, the public service applications (Union and State) from the intending candidates, project data, the present scientific manpower Register, etc., which can be classified and analysed in the light of the Scientific Personnel Committee's requirements. Then, sample surveys are also to be conducted. It will also be necessary to collect relevant data from the foreign countries and interpret them to derive conclusions to be applicable for our country's planning.

-ooOoo-

Interest

Brillouin: not correct

*1/8

Incidentally

Wiener = || class of fns =

---

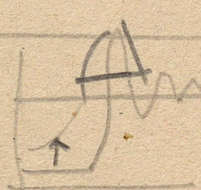
dn/ds:

(a)

(b)

(c)

Dependence on β.



Critical opalescence

How explained = λ^2 formula

Increases more rapidly in purple

= λ^4

$\frac{1}{\lambda^4}$

$\frac{1}{\lambda^4}$

10. Special training programme for engineers on modern science and scientific methods

Short term programme to acquaint the engineers with modern science for handling new types of jobs, e.g. Atomic power structures, use of radioactive substances, ultrasonics, etc. for engineering testing; statistical methods for quality control; operational research; etc. etc.
(Remark: Items 8, 9 & 10 will give advantageous mobility and interchangeability)

11. Job-evaluation for pay fixing:

The present method of pay fixing is purely arbitrary and based on convention.

The disparity can be controlled only through adopting a sensible job-evaluation plan. The scientific method may have to be introduced sooner if the ever-drifting policy of pay reviewing is to be avoided.

12. To formulate a uniform, comprehensive, and quantitative Merit-rating plan

This is for quick and deserving promotion incentive.

The present system of merit rating by qualification and vague "annual confidential report" is to be scrutinised and replaced, if necessary, by a suitable quantitative point-system on well defined merit factors. Scientific calibres should be graded properly and in a positive manner.

13. Reviewing the usefulness of the present scientific manpower Register, and consideration of its modification, if necessary. (See Appendix IV)

The above 13 points give a general outline of the manner of attack to be launched on the scientific

....5

8

Investigations Optical Anisotropy

$\frac{6(1-\nu)}{6-7\nu}$ ≠ Anisotropy very different

Blue of sky due to multiple scatter
Also.

~~Allied phenomena~~

Tyndall.

Allied phenomena

1) Kerr
2) Cotton Mouton.
3) Stream flow
   Colloidal particles. gemop.

7. <u>The question of recognition of scientific (purely scientific) education as xx technical or specialized education (like engineering etc.)</u>

Under the present classification, a science graduate (B.Sc. or M.Sc.) is counted under general education. It may be necessary to set a level, say B.Sc.(Hon.), from and above which they should be recognized as having specialized education and fit for scientific services.

8. <u>Mobilization of the scientists in engineering and technological fields</u>

Some jobs, conventionally handled by engineers and technologists, can be handled by scientists directly or by a short time job-training. This would release many of the not-fully-utilized engineers and technologists for engaging them in the appropriate jobs.

A study is necessary to find out the types of 'technical' jobs which can be handled by the scientists.

Study is also necessary where a combination or team work of scientists and engineers would be better fruitful than a unit of purely engineers or purely scientists.

9. <u>Special training programme for scientists for engineering and technological type of work</u>

Such programme on short term basis would make the scientists more useful in industry and construction activities.

Suitable syllabus can be worked out.

.....4

9 :
//

Liquid Mixtures.

Insoluble particles // Colloids = Kishn = Turbidity Mies :

3. Assessment of scientific and technical personnel requirement in the various fields split up for public and private sectors

This will need a detailed study and will form the core of the studies of vital importance for the technological, scientific and industrial progress of India. (This contention is explained in Appendix I)

4. Study of the migratory tendencies of the scientific personnel

Do the scientific personnel show a specially marked tendency to migrate?

If so, what are the major causes?

5. Study of the idle or wasted scientific personnel, and job openings

Is there sufficient number of scientific job openings?

Do the organizations, which should employ scientific personnel, actually employ them?

Are the Indian production and service units unduly oblivious to the utility of scientific personnel?

How can the scientific attitude be best xx introduced in government agencies and private industries?

6. Comparative study of the service conditions and grades of scientific personnel with Administrative and other cadres of services

It has to be seen, based on factual data, whether or how the scientific services are generally less attractive than Administrative and other types of services, regarding pay scale and administrative stratification. (See also Appendix III)

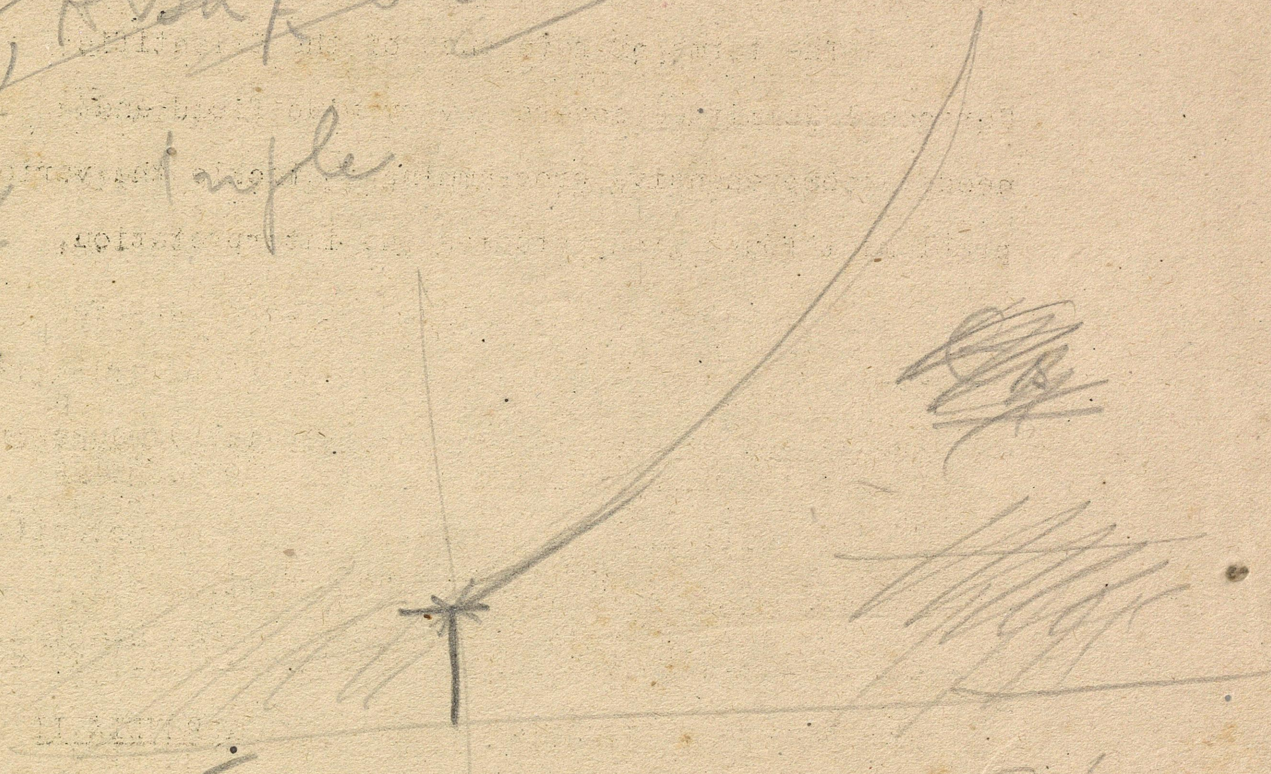
....3

pass.

~~1.2 Albn + Dec ultraviolet~~

31 Triple

~~44~~



Albn 1953

27, 28, 29, 30

31 Intensity scatts [illegible]

32

1952 17, 26

1951 5, 8, 12 ?

1, 1

7 13

Agcl :

APPENDIX II

A general outline of the field of Work of the Scientific Personnel Committee.

The terms of reference of the Scientific Personnel Committee covers a very wide field and needs a comprehensive programming to tackle the various problems through group studies and interpretation. Such a programme will have to be formulated in the light of short and long term needs, starting with those connected with the Second Five Year Plan.

The outline of the field of work is given below:-

1. Assessment of scientific (and technical) manpower available in the country in the various fields

It will also be necessary to define scientific and technical personnel, and to restrict or otherwise the Committee's consideration within a certain type or grade of personnel, as may be thought fit. (See also item 7, and Appendix III, page 3)

2. Classification of existing scientific and technical jobs in respect of designation and pay, and the qualifications required thereof

Attempt should be made to classify them in well-defined groups. Despite various prevalent designations, it may be possible to define them in terms of service levels of 1, 2, 3, etc. which would reasonably pin down pay-grade, qualification and status. Such numbering systems are followed in the U.S. Govt., known as General Service grades, both for Administrative and Technical services and the levels run as GS-1, GS-2, GS-3 upto GS-15.

....2

In spite of diffusion intensity near the Curie point, the polarization of the diffused light is also changing. In a state of equilibrium, like in $BaTiO_3$ above the Curie point, the double light refraction is absent, and below the Curie point, the crystal appears anisotropic. The diffusion, therefore, associated with P_s^2 fluctuations appears strikingly depolorized. The quantitative determination of this depolarisation and of all the other mentioned effects, taking into consideration the crystal structure of the diffusing substance, was not carried out. The problem of kinetics of fluctuation of the parameter ξ was also not studied; probably these fluctuations appear very small so that they only affect the central component in the spectrum of the diffused light.

Except for Seignette's salts, the characteristics of light diffusion can be observed in a quartz where the transition to β-phase at $\theta = 573^\circ$ C is near the critical Curie point. The possibility of studying experimentally other substances in which transitions of second order exist is not excluded i.e. ferrites, antiferromagnetics*

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Institute of Physics, Academy of Sciences, U.S.S.R.

Received
23. 5. 1955.

--ooOOKOOoo--

* It may be noted that in ferromagnetics near the Curie point where the fluctuation M_s^2 (M_s -- spontaneous magnetization) depends strongly on temperature the diffused scattering of neutrons is analogous to the incoherant diffusion of Roentgen rays observed[6]. Such is the nature of the effect observed in[12]. A similar scattering of neutrons takes place in the case of antiferromagnetics.

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Ratcliffe + Appleton Phil. Mag
42 201 1921 On the
form of the triode
vibrations:

---

a) what part does Thomson
coeff. play?

b) ~~———~~ Coeff. due
to pulling of electrons
connect. with specific
heat =

I.T.U.

Atlas of propagation
curves to be published
shortly by CCIR
& Pol.

Ramanujan's notes =
when not be published
Inform to Pol
=

~~Enter in Engagement book~~

1. Ramachandran
2. chandrasekar
3. Krishna Prof.
4 VRR
5. Varma

Mohan Singh

420
100 60
420 2
420 x 60
252 1/10

405
405

2322

4-

1 Power reactor — D.I. Blokhintsev + N.A. Nikolaev.

Arctic Soviet country — A.N. Lavrishchev

Inelastic Scatt fast neutrons — M.V. Pasechnik

Neutron B-decay — P.E. Spivak

Heavy water Gr Reactor — A.I. Alichanov

200 kW thermal Tow nuclear reactor for Gr pounds — N.A. Nikolaev

Reactor for Research & technical investigations — G.N. Kruzilin

Homogeneous + power producing water boiler — A.I. Alichanov

16 A.

Neutron Spectrometer
mechanical interpter } V. V. Vladimirsky

X Section . . Y. V. Adamchuk

Time of flight S. J. Nikitin

Abs x sects } G. H. Kukavadse

Fission Reaction
analy } Spivak
Alikanov
Pomyow

Cyclic. { Ledermann
{ Peierls :

1 Cm. thickness. { μ | 10^{-4}
surface atoms.

the relative error is of the order of 0.06 %.

~~A~~ For every R consider

ν : Determination of velocities.

Interaction of pairs: $U = -\frac{\alpha e^2}{R} + n_0 \phi(R)$ — some short-range

$\phi(R) = A e^{-R/\beta}$

$\left(\frac{\partial U}{\partial R}\right)_{R=d} = 0$

$\left(\frac{\partial^2 U}{\partial R^2}\right)_{R=d} = \beta \cdot q/(N\beta d^4)$

N = no of unipairs per unit vol.

$\delta - 2 = qd/N\alpha e^2 \beta$.

$(= n_i - 1)$.

Consider a dense medium consisting of optically isotropic molecules.

Consider scattering in a given angle ϕ.

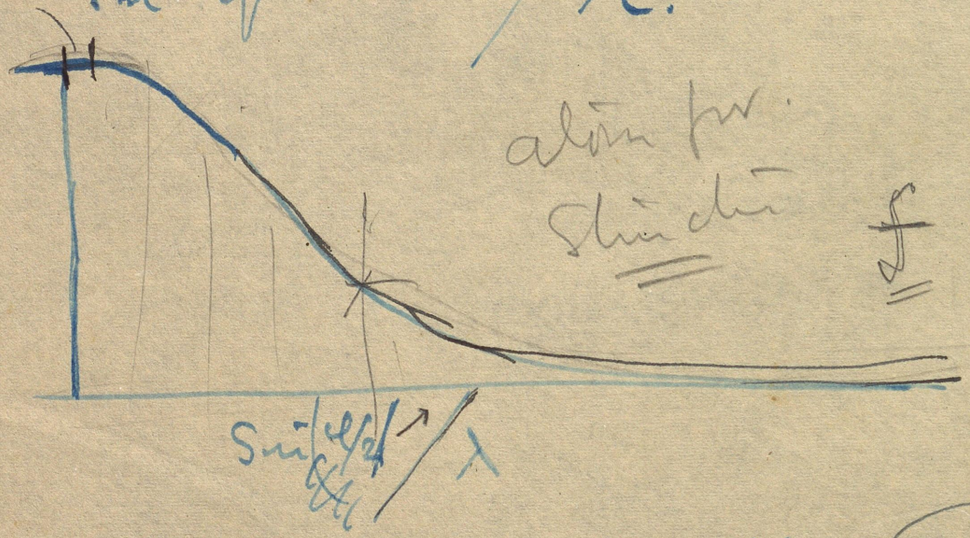
I_ϕ due to one molecule $\propto$

i.e. form factor in X-ray.

$1+\cos^2\phi$ term due to polarization.

$\frac{\omega^2}{\omega_0^2 - \omega^2}$

Fn of $\sin\phi/2 / \lambda$.



In a gas $= n\alpha$

In a liquid owing to correlation in phase betn neighbouring particles $f n \alpha$ where $f \ll 1$. [v'/50]

If a uniform medium scatters at all

Theories of scattering are concerned with calculating f.

In a gas that obeys Boyle's law we have seen that the scatt. from even neighbouring molecules are of random phase, and hence $f = 1$. This will be so even in a liquid provided the wave-length λ is short enough in comparison with the interatomic distance; ~~and if in which case the~~ This is so with short X-radiations & the region on the R-hand side corresponds to it.

small thermal changes in distance due to thermal agitation would correspond to large variations in phase & hence ...

The other extreme is near the centre, ~~for~~ when $\sin\theta/2/\lambda$ is very small. i.e. ~~when the~~ for forward scattering in X-rays or for scattering in any direction for light-waves, i.e. where the distances between ~~adjacent~~ neighbouring molecules is small.

~~We~~ For the present-

shall consider $\lambda \gg d$. This is so with light waves since in a cubic ~~cm~~ λ there will be molecules.

Start with probability =

$$\frac{\overline{\Delta n^2}}{n^2} = KT\beta \cdot [$$

$\left(\overline{\Delta n^2}\right)^{1/2}$ will ~~be~~ in effect be the ~~Δq~~ ~~effective~~ no. of molecules per cc that scatter, and ~~since~~ this effective no will all scatter in same phase. (their amp. to be added) / Hence

scatty coeff. = $|\Delta N^2|$ this ~~=~~ scatty per mc. molec.

Why we write like this.

~~when~~ For a gas $n^2 KT\beta = 1$

Hence ~~=~~ reduces to previous formula.

For a gas $\overline{\Delta n^2} = n^2$

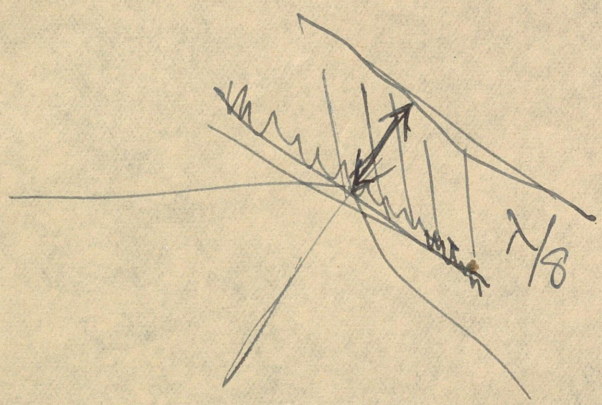
Hence 2 alternatives. ~~ΔN~~. The ~~$\overline{\Delta n^2}$~~ actual no of molecules ~~=~~ the scatter in random phases.

effective no. $\sqrt{\Delta n^2} = \sqrt{n}$ & they all scatter in same phase.

$= n\sigma$ // ~~On~~

In choosing element of vol. Rayl criterion max diffce of phase shd be < $\lambda/4$

Instead of taking the flux in a small element of vol. one can take a layer ± oriented as large as $\frac{\lambda/8}{\sin \theta/2}$



Lorentz

Boyle's law, tho' a sufficient condition is not a necessary condn for seeing $f = 1$ = when $\frac{\sin\theta/2\, t}{\lambda}$ is large; since $\sin\theta/2$ cannot exceed unity λ small

---

But the earliest method is still the best. Has many advantages Avoids many uncertainties.

Regarded as reflection for appropriate waves:

Brillouin's error 1/8.

$(\partial\varepsilon/\partial\mu)$ . . .

Effect of anisotropy:

Critical opalescence

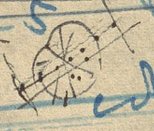
All theories of dispersion based on the development of dipoles, induced by the incident Electric field: with certain natural frequencies. If it were a gas, in which the influence of the dipoles on one another is negligible, the susceptibility χ, if the polarization induced per unit field in the med, is just n times α (where α is the polariz.ty per molec, and n is the no. per unit vol.

$$\chi = \frac{n^2-1}{4\pi} = \sum \frac{}{\Omega_i^2 - \omega^2}$$

We are neglecting the permanent dipole: Treated separately in QM:

When the med is a dense one, interactions between the

dipoles becomes considerable
+ has to be taken into
account.

~~Drude's~~ ~~formula refined~~
: Hall  ~~den~~ ~~under influence~~
~~of a~~ ~~time~~

One obvious way of taking
it account is that due to
Lorentz:

the field acting a molec.
which induces the dipole moment
is not merely the field in the
med but includes in addition
what is known as the polarization
field; ~~which~~ which can be
readily calculated under the
following special conditions:

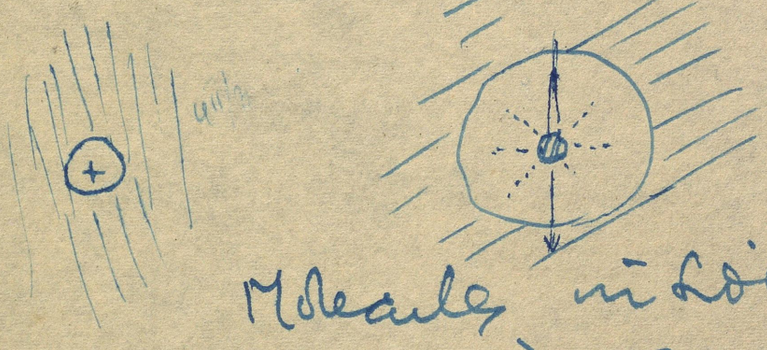
Inner field
Polarization
Field in med.

(a) that the dipoles may be regarded
as point dipoles, i.e. the separation
of the charges is ~~small~~ $\ll$ mol. radius
$\ll 1/n^{1/3}$.

(b) the dipoles are arranged

at the points of a simple cubic lattice
or are distributed at random.

Lorentz's calculation is as follows. molecules outside Uniform



$4\pi/3$ P.

Molecules in Sphere ——— Zero (If cubic or random)

Richardson.

In fact the separation of the sphere is just for avoiding the uncertain part. But there is no need for dividing this way if the distribution is cubic.

Darwin's $4\pi/3$.

$-\frac{8\pi}{3}$.

=

Van Vleck's treatment.
Same true for random distribution.

$\frac{n^2-1}{n^2+2} = (\quad) \quad \alpha.$

$(n^2+2)/3$ being the ex. lie factor

$n^2 + \alpha \quad \mu \neq 4\pi/3.$

Reason to Drude when pol^n. field is zero: as it did since D's derivation did not contemplate the existence of a pol^n field at all.

D's theory therefore regarded as a special case applicable when $\mu \to 0$

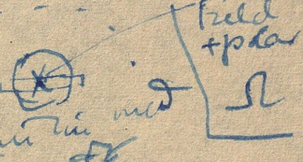
This is not actually so.

‖ ✱ Due to the following circumstance: Before taking it up.

Verification: NaCl: Unexpected manner. α^2 In calculating ω^2 pol^n field has to be taken into ac. Has to be $4\pi/3$. Di-poles: Cubic arrgmt. regd by Lorentz.

Important distinction: Difference between field in the medium, and the inner field, is that the former includes a certain averaged self-field due to the doublet at 0 also, whereas the latter does not.

Polarization =



Explicit version: Natt:

~~Ω^2 vs ω^2~~ Ω vs ω

= this introduces us to an alternative way of taking into account the effect of the polarn. field on frequency:

+ Polarn. field Ω

+ no " " ω:

~~For any dense medium:~~

~~Latter~~ leads to Drude.

Now in any actual dense med, eg a liquid

a) no pol. dipoles:

b) no cubic anyt. mg not be random

Even so, with a certain r_{ij} instead of $4\pi/3$, characteristic of interactions between any two types of oscillators, when all the r_{ij}'s are different, it is known that the Drude formula will be applicable

$$\frac{n^2-1}{4\pi} = \chi = \sum \chi_i$$

$$\chi_i = \frac{1}{\Omega_i^2 - \omega^2}\left(1 + \sum r_{ij}\chi_j\right)$$

Hence even in such a complicated case the effect of the polarization field on the refractive index is completely taken into account by its effect on both the F_i's and Ω_i's.

---

old controversy whether the Drude or the Lorentz formula for dispersion is valid, and the proposals to

verify experimentally have no meaning. (Ramachandra.) If Drude's will naturally ~~is the Correct~~ ~~one~~ hold, and the frequencies ω_i appearing in it are the natural frequencies of the med. that can directly be observed, since they are the resonance/absorption frequencies of the medium.

This will imply that corresponding to each such frequency 2 constants F_i and ω_i can be determined ~~experimentally~~ from the expt'l data for n^2 as a fn of ω. These data can not give any information regarding the (existence or strength of a) static field, and much less its magnitude.

Since the data involve $2n$ constants, the data can be fitted with any such formula, purely algebraically, containing $2n$ constants, ~~the Constants~~ eg. $\frac{n^2-1}{n^2+\alpha} = \ldots$

or in particular $\frac{n-1}{n+2} = \ldots$

the frequencies Ω appear in this formula would have no direct significance. They would merely indicate that if the polarization field constants k_{ij} ~~were all~~ being identical, and $= 4\pi/3$ or ... (in the latter case) then Ω_i would be hypothetical frequencies which the molecules should have in order to exhibit the kind of dispersion that is actually observed. The Ω's would not of course be the actual Ω's of the isolated molecules, unless the actual polarization constants happened to have the values which we postulated arbitrarily.

Did H. L. to decide between the two formulae?

Herzfeld showed several years ago that Lorentz can be reduced to Drude, in the special case when the number of frequencies involved is 2; he says (as he states in his paper) it is easy to show, it applies to $n > 2$ also. Converse also true.

On the other hand n^2 as a fn of density will naturally depend very much on the polarization field.

In the special case when all the p's are identical it should be possible from the values in the vapour & liquid states to determine p in the liquid.

Rare gases

Benzene &c.

$$\frac{dn}{dt} = \frac{dn}{d\rho} * \frac{d\rho}{dt}$$

the effect of temp as such should be negligible. So it might appear at first sight that $\frac{dn}{dt}$ should enable us to determine the polarization field. this is not so since p itself is a function of density.

(A) Rozprawka

p. 9 10

C_6H_6 1) Knowing for one wavelength precisely $\mu_{vap.}$ & μ_{liquid} one can calculate ~~it~~ ρ. [Assuming all ρ_{ij}'s are the same]

. Is the value of ρ calculated for different wave-lengths in this manner the same?

2) If there is a single ρ and dispersion ~~of~~ data are available for the vapour and for the liquid we should be able to get all the ~~ρ_i's~~ Ω_i's from the ~~Ω_i~~ ω_i's knowing ρ, & vice versa from the ρ's. It would be interesting if we could do it.

3) Are there similar data for such molecules CS_2, N_2, O_2, ~~of~~ methane, ethane!

Drude formula in which
ω of the med, as distinguished
from λ, occurs applicable to
rotatory dispersion also.
Investigate in detail.

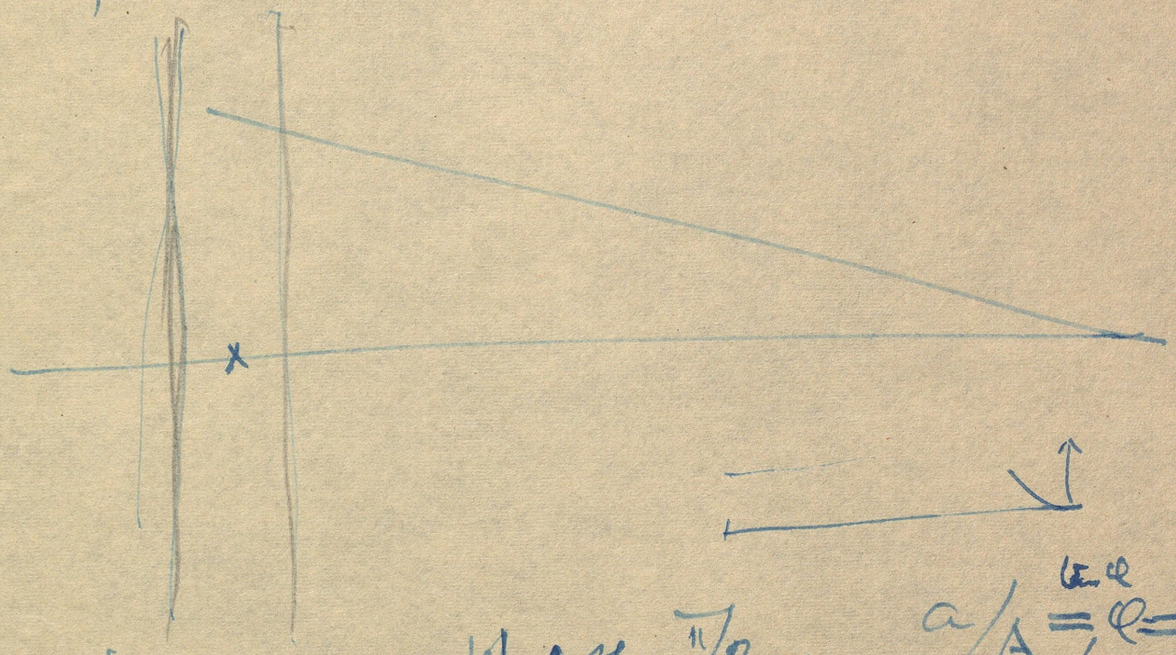
Exptal methods of determ
dispersion. Some Exptal data.

Solutions: will not
dependence on concentration under
variation of ω or concentration

Absorption

Esp. of sthg: position as dependent
on concentration + Lorentz
field :

The ~~Existence~~ reality of a ref. index, which deviates from 1, due to scattering.



change of phase $\pi/2$. $a/\lambda \ll 1$

$= \frac{2\pi}{\lambda} \times (\mu - 1)\, d.$

Reflection from surface of a liquid ~~unlike in a metal~~ a) change of phase of π. as due to $-\pi/2 + \pi/2$.

b) By Babinet: No change of phase when: ...

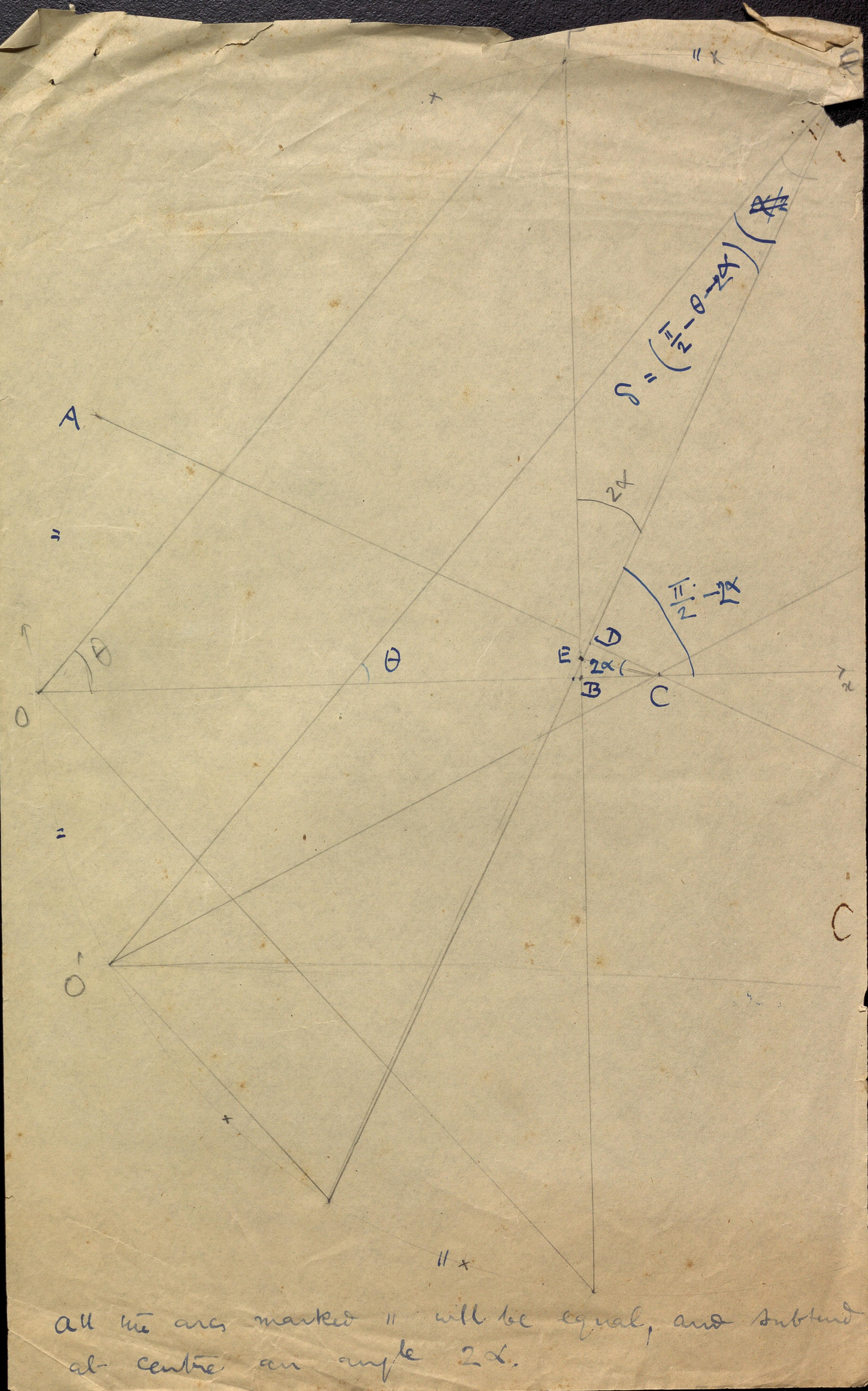
(c) Existence of Brewsterian ...

Jamin: Extra term: Not given in ~~Schuster~~ Drude.

~~Then~~ Even without any extra layer.

With an oil film ...

As distinguished from surface scattering.



all the arcs marked ‖ will be equal, and subtend at centre an angle 2α.

Let R be the radius of the sphere

$OB\ (= AD)$ will be given by

$$OB(2R - OB) = BP^2 = OB^2 \tan^2\theta$$

$$2R \times OB = OB^2(1 + \tan^2\theta)$$

$$\therefore OB = 2R\cos^2\theta = d \text{ say}$$

$$BP = r = 2R\cos^2\theta \tan\theta = R \sin 2\theta.$$

Consider a BP rotated by an angle ϕ about OB [P denoting the new position of P] and similarly DP' rotated about AD by ϕ, P' denoting the new position of P'. Required to find whether OP and OP' are ||^{l}.

The coordinates of P are

$$d = 2R\cos^2\theta, \quad r\cos\phi = R\sin 2\theta \cos\phi,$$
$$r\sin\phi = R\sin 2\theta \sin\phi.$$

The direction cosines of OP are given by

$$l : m : n = 2\cos^2\theta : \sin 2\theta \cos\phi : \sin 2\theta \sin\phi$$

l, m, n are $= \cos\theta : \sin\theta\cos\phi : \sin\theta\sin\phi$

The coordinates of P' are as follows:-

$$BC = (R - 2R\cos^2\theta) = -R\cos 2\theta$$

$$BE = DE = -R\cos 2\theta \tan\frac{\phi}{2}.$$

$\therefore$ the coord. of P' are

$$\left(R\sin 2\theta\cos\phi - R\cos 2\theta \tan\frac{\phi}{2}\right) \cos\left(\theta + \frac{\phi}{2}\right) + 2R\cos^2\theta,$$
$$\sin\left(\theta + \frac{\phi}{2}\right) - 2R\cos 2\theta \tan\frac{\phi}{2}$$

(" $R\sin 2\theta \times \sin\phi$.

The coordinates of P' are as follows:

$BC = R - 2R\cos^2\theta = -R\cos 2\theta$

$BE = DE = -R\cos 2\theta \cdot \tan\alpha$

$\delta = \frac{\pi}{2} - \theta - 2\alpha$

∴ the coordinates of P' are

$(R\sin 2\theta\cos\varphi - R\cos 2\theta\tan\alpha)\ \underbrace{\cos(\theta+\delta)}_{=\sin 2\alpha} + 2R\cos^2\theta$

$(\quad\text{"}\quad\text{"}\quad)\ \underbrace{\sin(\theta+\delta)}_{=\cos 2\alpha} - 2R\cos 2\theta\tan\alpha$

$R\sin 2\theta\cdot\sin\varphi.$

The coordinates of O' are

$R(1-\cos 2\alpha),\ -R\sin 2\alpha,\ 0$

$2R\sin^2\alpha$

The direction cosines of O'P' will be given by

$l' : m' : n'$.

$= (R\sin 2\theta\cos\varphi - R\cos 2\theta\tan\alpha)\sin 2\alpha + 2R\cos^2\theta + 2R\sin^2\alpha$

$: (R\sin 2\theta\cos\varphi - R\cos 2\theta\tan\alpha)\cos 2\alpha - 2R\cos 2\theta\tan\alpha + R\sin 2\alpha$

$: R\sin 2\theta\sin\varphi$

For the spl. case $\varphi = 0$ formula does not correspond to Wilson check.