takes the line of least resistance through C, thus reducing the amplification of the valve abruptly and considerably. As long as the charging current continues to flow — that is, during a considerable part, if not the whole, of the pulse period (since the considerable amount of charge at first released must now be made good) — the pulse is unable to develop to its full height and is therefore distorted and attenuated. This effect may attain such proportions as to upset the synchronization of the picture.

This explains why it is necessary in this application to employ a diode exhibiting only a small leakage at the high reverse voltages involved.

Summary. Among the obvious advantages of germanium diodes compared with their vacuum equivalents, are their relatively small size and weight and the fact that they contain no filament. As regards the normal functions of a diode, that is, rectification and detection, the leakage current of the germanium diode and its superior forward characteristic, constitute the most striking differences between it and the vacuum diode. The effect of these differences upon the detection efficiency and equivalent attenuation resistance in a detector circuit is investigated. It is shown that germanium diodes can be employed in a very large number of cases and that, provided that the load-resistance is low and the signal voltage and ambient temperature are not unduly high, the performance of such a diode is even better than that of a vacuum diode. Special germanium diodes have been developed for certain purposes, e.g. to operate at high frequencies (video detection in a television receiver) and for use as D.C. restorers for maintaining the black level in the picture tube of a TV receiver.

SEDIMENTATION OF FLUORESCENT SCREENS IN CATHODE RAY TUBES

by F. de BOER and H. EMMENS.

The ever-increasing use of cathode ray tubes for television and other purposes creates the need for a sufficiently reproducible method of forming the fluorescent screen in the tube. The problems thereby involved are largely of a colloid-chemical nature. A detailed study of the effects occurring on sedimentation of the screen is possible only if the chemical composition of the layer is known. This composition can be determined with the aid of radio-active tracers.

Introduction

The fluorescent screens of picture-tubes and other types of cathode ray tube are composed of a mixture of substances. The fluorescent substance itself, the so-called phosphor, of course predominates, but for the deposition of the screen it is necessary to include a number of components to ensure a sufficiently adhesive and finely grained layer. These admixtures affect the characteristics of the screen, such as the secondary emission factor. If this is too low, heavy negative charging of the (insulated) screen will occur during use, to the detriment of the luminous efficiency and fidelity of reproduction 1). On the other hand, the content of non-fluorescent substances must not be too high, as this also has an unfavourable effect on the fluorescent efficiency. It is therefore necessary to select and apportion the additional constituents with care.

The method of preparation of fluorescent mixtures nowadays employed is as follows. The fluorescent grains are suspended in water containing waterglass (a colloidal solution of potassium silicate in water with excess silica). A gelatinising agent is also added. This suspension is poured into the tube and, after a certain time, the powder settles to form a uniform, closely adhering layer, the solvent being then poured off. Fig. 1 shows how this is done in manufacture.

The use of a gelatinising agent is necessary to prevent the layer of sediment from sliding to one side and also to prevent individual granules from becoming detached, when the tube is tilted in the decanting process. Moreover, in the dry condition, during exhaustion of the tube as well as during use, effective adhesion of the granules must be guaranteed; the presence of loose granules in a tube operated at high voltages must be avoided at all costs.

Until a few years ago the gelatinising medium used was potassium sulphate, but a disadvantage of this "sulphate" method is that it takes some time to produce a sufficiently adhesive layer, viz. 1 to 2 hours. A more rapidly reacting medium was therefore sought. Such a medium was found among certain soluble calcium or barium salts, of which barium nitrate, for example, produces a firmly

---

attached layer in roughly 15 minutes. This represents a considerable advantage in mass production, but the use of barium salts for this purpose nevertheless has the disadvantage that the secondary emission factor of the deposited screen is lower than that of screens made by the sulphate method. Particularly in modern tubes, operated with very high acceleration potentials — at which the secondary emission is in any case fairly low — this is an important consideration.

It will be obvious that the adhesive properties of the settled screen depend upon the composition of the solution. Screens prepared in accordance with the barium method yield the curve depicted in fig. 2. The various concentrations must be selected within the area to the right of the curve $BAC$ in order to ensure a sufficiently adhesive layer. We shall refer to this diagram again later.

In order further to clarify the processes that take place while the layer is being formed, and to observe the relationship between the composition of the fluorescent screen and the secondary emission factor an investigation has been made into the potassium, barium and also the $\text{SiO}_2$ content of fluorescent screens prepared by the two different methods. This investigation, in which use was made of radio isotopes, will now be described briefly. First, however, it is worth considering the picture that has been built up of the actual mechanism of formation of the layer.

![Fig. 1. Photograph of the manufacturing process for the application of the screens to television picture tubes. The tubes enter the settling room on an overhead conveyor. Background: filling with the liquid containing the phosphor and binding agents in suspension. Foreground: decanting the liquid.](image)

![Fig. 2. Curve defining the conditions for adhesion of the fluorescent screen of a cathode ray tube. Vertical axis: concentration (% by wt) of waterglass, i.e. $\text{SiO}_2$, in the sedimentation liquid; horizontal axis: concentration of gelatinising medium (barium nitrate). In the area enclosed within the curve $BAC$ effective adhesion of the screen is obtained.](image)
Mechanism of formation of the layer

In the suspension, the granules of the fluorescent powder are coated with a slowly forming layer of silicate, and during sedimentation these layers come into contact with each other and coalesce into a gel, resulting in considerable mutual adhesion between the granules, and between them and the glass tube. In the absence of a gelatinising agent, hardly any gelling can take place, the adhesion is inadequate and the ultimate layer unstable.

Potassium sulphate owes its gelatinising properties solely to the electrostatic effect of the potassium ions, which partially neutralises the mutual electrostatic repulsion of the silica acid groups and thus promotes gelation. The potassium ions do not themselves function as constructional elements in the resultant gel and are therefore capable, in principle, of securing the adhesion of a practically unlimited number of granules. However, the gelatinising process takes a relatively long time for its completion (viz 1 to 2 hours, dependent on the potassium content) and hence much longer than the actual sedimentation.

Under otherwise similar conditions (equal acidity) barium salts produce much more rapid gelatinisation. (in about 20 minutes), but in the resultant gel the barium ions probably occur in the form of a compound. Once the gelatinisation is completed, no more barium ions will be available in the suspension, and granules which have by then not become attached to each other will not do so with the passage of time. The size of the granules in layers settled by the barium method are therefore, for a given barium concentration, limited.

Even without any fluorescent powder at all the presence of barium salts in the potassium silicate results in a gel, as seen by increasing turbidity of the liquid.

Determination of the composition of the layer

The composition of screens produced by the sulphate method can be easily determined by drying the settled layer after decanting the liquor, and leaching with distilled water. The phosphor granules do not dissolve, but the SiO₂-K₂O compound binding them together (briefly called binders in the following) do, and the solution can be analysed.

In the case of screens made with barium nitrate, however, such chemical analysis does not yield the desired results. Barium and potassium (from the water glass) are then both present and it is not a simple matter to separate the very small quantities concerned. A solution to this difficulty has been found in the use of radioactive tracers, viz. Ba¹³³ (an artificial barium isotope of atomic weight 133), and K¹² (potassium isotope, atomic weight 42). Both isotopes were prepared in the cyclotron at Amsterdam ³). Ba¹³³ has a half-life of 38.8 hours and it emits both soft γ radiation, with an energy of 0.3 MeV, and β radiation (conversion electrons). Neither radiation is very dangerous provided that the necessary precautions are taken in effecting the analysis. The half-life of K¹² is shorter than that of Ba¹³³, viz. 12.4 hours, and the radiation emitted (γ) is harder and less innocuous; the energy is 1.5 MeV. As the time elapsing between preparation of the isotopes and their arrival at Eindhoven was about 16 hours, i.e. of the same order as the half-lives just mentioned, it was necessary to carry out the investigation immediately on receipt of the isotopes.

The barium in the form of the nitrate was received in bottles, packed in lead and consisting of a solution of 100 mg nitrate in 100 cc water. Immediately on receipt the solution was diluted with 500 cc distilled water, the necessary precautions being observed. Owing to absorption of the electrons in the water the isotope was thus rendered safe enough to carry out the various operations by hand, provided that this was done reasonably quickly.

The radioactive potassium arrived as an aqueous solution of KCl and was similarly diluted. This solution could also be handled quite safely in the ordinary way for a short period of time.

To a known quantity of the solution to be used for the screens, and containing the normal barium nitrate, 50 cc of the radioactive solution was added. Because of the chemical identity of all barium atoms, regardless of their weight, a homogeneous mixture of radioactive and non-radioactive barium results: hence the radioactivity of a portion of the mixture is a measure of the total quantity of barium in that portion. After sedimentation the liquid was decanted from the tubes by mechanical means. In this way 99 % of the radioactive substances was disposed of down the sink where, owing to the degree of dilution and the short half-life, they could do no harm locally. The residual radiations within the tube were also harmless. When dried, the deposited fluorescent powder was scraped off and spread out on an aluminium dish and the barium content was ascertained by measurement of the radiation intensity with a Geiger counter. For control purposes, a count was first taken from a preparation containing the same quantity of

fluorescent powder and a known quantity of Ba\textsuperscript{133} of the same age as that used in the analysis.

To determine the quantity of potassium in the deposited layer, a similar procedure was followed, except that in this case 50 cc of the radioactive potassium solution was initially added to the normal barium nitrate solution.

The necessary correction was of course made for the background counts (cosmic radiation, etc).

The SiO\textsubscript{2} content of the powder was determined by normal chemical methods.

Results of the investigation

The table below gives some of the results relating to the proportions of BaO and SiO\textsubscript{2} in the binder as a function of the concentration of barium nitrate and potassium silicate in the liquid. From this it is seen that the molecular ratio BaO-SiO\textsubscript{2} in the binder is practically independent of the composition of the liquid, which agrees with the view expressed above that we are not here concerned with an evaporated solution yielding a mixture, but that the barium and SiO\textsubscript{2} are present in the binder in the form of a sort of compound. Another argument in favour of this conclusion is that the quantity of binder is roughly proportional to the Ba content of the solution. On the other hand, a very strong binding, of the nature of an adsorption, could explain these facts.

In fig. 3 the K\textsubscript{2}O-SiO\textsubscript{2} ratio in the binder is shown plotted against the concentration of potassium silicate in the solution. Curve 1 refers to screens made by the sulphate method, and curve 2 to the barium nitrate method. Clearly there is no question of the K\textsubscript{2}O-SiO\textsubscript{2} ratio in the binder being constant. These conclusions are fully in accordance with what has been said above regarding the behaviour of the gelatinising media in the solution.

The diagram in fig. 2, representing the conditions for good adhesion of the settled screen can now be explained as follows. The line AB represents the (linear) relationship between the quantity of binder deposited and the barium concentration of the solution. To the left of A, the barium concentration is too low to produce a sufficiently adhesive layer, whilst below the line AB the SiO\textsubscript{2} content is too low. The time needed to ensure a properly adhesive layer increases with the concentration of potassium (derived from the water-glass), and, above the line AC this time is so long that the layer is no longer stable. The slope of the curve AC implies that adhesion is improved as the barium content of the solution is increased.

Some idea of the thickness of the adsorbed layer of binder around the phosphor granules can be obtained from the relationship between the absolute quantity of binder settled and the phosphor concentration of the suspension. This is shown in fig. 4; the relationship is practically linear. The intersection

Table. Analysis of the molecular ratio BaO-SiO\textsubscript{2} in sedimented layers.

<table>
<thead>
<tr>
<th>Percentage by weight Ba(NO\textsubscript{3})\textsubscript{2} in the liquid</th>
<th>Percentage by weight SiO\textsubscript{2} in the liquid</th>
<th>Molec. ratio BaO-SiO\textsubscript{2} in liquid</th>
<th>Molec. ratio BaO-SiO\textsubscript{2} in binder</th>
<th>Quantity of binder deposited</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02 %</td>
<td>0.25 %</td>
<td>1:32</td>
<td>1:16</td>
<td>1.5 mg</td>
</tr>
<tr>
<td>0.02</td>
<td>0.38</td>
<td>1:48</td>
<td>1:18</td>
<td>1.2</td>
</tr>
<tr>
<td>0.02</td>
<td>0.53</td>
<td>1:64</td>
<td>1:16</td>
<td>1.3</td>
</tr>
<tr>
<td>0.01</td>
<td>0.12</td>
<td>1:32</td>
<td>1:19</td>
<td>0.7</td>
</tr>
<tr>
<td>0.01</td>
<td>0.19</td>
<td>1:48</td>
<td>1:19</td>
<td>0.7</td>
</tr>
<tr>
<td>0.01</td>
<td>0.26</td>
<td>1:64</td>
<td>1:22</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Table. Analysis of the molecular ratio BaO-SiO\textsubscript{2} in sedimented layers.
of the curve on the vertical axis is a measure of the quantity of binder deposited on the glass screen. If the grain size of the phosphor be known it is possible to calculate from the slope of the line the quantity of binder per granule and, from this, the thickness of the adsorbed layer. A thickness of the order of 100 Å (10^{-6} cm) was found, and this agrees with the results of tests to ascertain the acceleration voltage that has to be applied to the tube to produce perceptible fluorescence. The acceleration voltage determines the depth of penetration of the electrons into the layer of binder. It is found that the penetration depth appropriate to the observed minimum acceleration voltage is also of the order of 100 Å.

It is important, especially for high-voltage cathode-ray tubes, that the potassium concentration in the screen should be as high as possible since, as explained above and as shown in fig. 5, this is accompanied by a high secondary emission factor of the screen. As indicated by the results plotted in fig. 3 this can be ensured by making the concentration of potassium silicate in the liquid as high as possible. This does not alter the BaO-SiO₃ ratio of the screen, but the time taken to secure satisfactory adhesion is increased.

As will be seen from fig. 3, the highest potassium concentration in the screen is obtained by employing the sulphate method; this concentration is of course reduced if part of the potassium be replaced by barium. On the other hand, as already pointed out, the addition of barium promotes rapid adhesion, so that it is necessary to aim at a composition for the suspension that will include enough barium to ensure reasonably rapid adhesion, but not so much that the secondary emission factor of the screen is reduced beyond the permissible limit.

Summary. The fluorescent screen in TV and other types of cathode ray tube is produced by sedimentation from a suspension. This article deals with the processes that take place during this desinulation. The effect of gelatinising agents on the adhesive properties of the screen is found to be very pronounced. Until recently potassium sulphate was used as gelatinising agent, but at the present time preference is given to barium salts, which promote more rapid adhesion. The chemical analysis of screens made from various solutions leads to some understanding of the behaviour of the gelatinising agents. For the analysis of the Ba and K in screens settled with barium salts, use was made of tracers, i.e. radio-isotopes of these elements, which also made possible an investigation into the effect of the composition on the secondary emission factor of the screen.

![Fig. 5. Secondary emission factor δ of the fluorescent screen plotted against the molecular ratio K₂O-SiO₂ in the binder. The points denoted by crosses relate to screens prepared by the sulphate method; those shown as circles relate to the barium method.](image)
Apart from the X-ray tube and generator and the equipment for observing the X-ray picture, a diagnostic apparatus must also be provided with mechanical means for placing the patient in any position necessary for the examination. The usual type of universal diagnostic apparatus provides for the tilting of the patient about a horizontal axis perpendicular to the X-ray beam, and the X-ray tube and fluorescent screen or camera must follow this movement.

With the new apparatus shown, this conventional arrangement has been abandoned in favour of a fixed X-ray source and screen. (The protective screening is then also fixed and the radiologist does not need to move in order to continuously observe the X-ray picture). Instead of tilting the patient about the above-mentioned axis, this apparatus can turn the patient about a horizontal axis parallel to the direction of the X-ray beam and about his longitudinal axis. In this way, quite new positions of the patient and new irradiation directions are possible, which may be of great value for the examination of certain organs.

The apparatus, which has been developed by H. Verse and K. Weigel of Hamburg, was first demonstrated at the 7th International Congress of Radiology in Copenhagen, 1953. The apparatus will be more fully described in this Review in due course.

1) H. Verse and K. Weigel, Ein geräte-technische Betrachtung zur Röntgendiagnostik, Fortschr. Röntgenstrahlen 80, 529-524, 1954, No. 4.

Chapter I deals with the so-called cathode lens, an electrostatic lens which differs from ordinary immersion systems in that the electrons leave the object with nearly zero velocity. The image iconoscope, in which the image is formed by a cathode lens placed in a rotationally symmetric magnetic field, is then briefly discussed. In Ch. II the electrostatic field is discussed. General solutions of the rotationally symmetric Laplace equation are applied to a case which resembles that of the image iconoscope. For measurement of the field a resistance network was used. This method is analyzed and improved.

In Ch. III the magnetic field of the deflection coil is dealt with. The measuring method of Van Mentz and Le Poole was used, and is examined as to accuracy. In Ch. IV the general and the paraxial equations for the trajectories are given, and the conditions specified under which the latter may be used. In Ch. V solutions of these equations in the form of expansions are found which lead to a general solution for the electron trajectories in the type of electron lens considered. In Ch. VI the paraxial trajectories in the Philips image iconoscope 5840/00 are calculated. A comparison is made between tubes with and without an “anode mesh”. The computing methods used are discussed at some length and examined as to their accuracy. The mechanism of the image formation is explained with the aid of the computed electron trajectories. The definition of cardinal points is adapted to the special character of this type of electron lens. In Ch. VII experiments are described which provide a relation between the shape of the imaging coil and the magnification and rotation of the image. These experiments lead to a type of coil which permits a continuously variable magnification without rotation of the image. Ch. VIII and IX deal with aberrations, ion spot and diamond distortion. Finally, in Ch. X, the application of variable magnification in television cameras is discussed (see also Philips tech. Rev. 14, 327-335, 1952/53).


If wurtzite, the hexagonal modification of ZnS, is compressed at room temperature, it changes into sphalerite, the cubic modification. This has been observed by X-ray diffraction. The gradual transition manifests itself also in the paramagnetic resonance spectrum of small quantities of Mn dissolved in ZnS. This is because the paramagnetic resonance spectrum of divalent manganese is very sensitive to the presence or absence of non-cubic components of the surrounding crystalline field. The spectrum as a function of Mn concentration is shown. In non-compressed wurtzite powders the complete spectrum is resolved at higher concentrations (0.05%) than had been reported before (0.001%) for compressed powders.


For a special spinel structure in which the spontaneous magnetization at a temperature $T_0$ below the Curie temperature ($T_C$) becomes zero, a method has been derived to determine the temperature $T_0$. A condition is derived for the extreme case $T_0 = T_C$ which can be applied to experiments for finding the ratio of mutual interactions of magnetic ions.


A simple dynamic model, in which the interatomic forces are simulated partially by magnetic forces and partially by the elastic forces exerted by small springs, is described. With it the movement of edge and screw dislocations through a crystal lattice can easily be demonstrated.


With the help of a model, consisting of an ellipsoid of ferrite with Bloch-walls perpendicular to one of the major axes, it has been demonstrated that considerable resonance losses can occur in ferrite throughout a very wide frequency band, viz. from the natural resonance frequency predicted by Snoek.
up to the frequency of the Larmor-precession in a
magnetic field of intensity of $4\pi M_s$, where $M_s$ represents
the saturation moment of the ferrite.

2110: H. P. J. Wijn, M. Gevers and C. M. van der
Burgt: Note on the high frequency dispersion
in nickel zinc ferrites (Rev. mod. Phys. 25,
91-92, 1953)

In connection with a publication by Rado and
others regarding two dispersion regions in ferrites,
the behaviour of the imaginary component $\mu''$ of
the initial permeability ($\mu = \mu' - j\mu''$) is investigat-
ged in the frequency range $3\text{Mc}/s - 3000\text{Mc}/s$,
in nickel-zinc ferrites of various compositions
(18-50% NiO, 32-0% ZnO). No more than one
resonance maximum is found. It is concluded from
the behaviour of $\mu'_r$ as a function of the frequency
during tensile stresses (up to $2.7\text{kg/mm}^2$), that the
dispersion in these ferrites is linked up with a
rotation process of the spin vectors.

2111: H. P. J. Wijn and H. van der Heide: A
Richter type after-effect in ferrites con-
taining ferrous and ferric ions (Rev. mod.
Phys. 25, 98-99, 1953)

With manganese-zinc ferrite (28 MnO, 19 ZnO,
3 FeO, 50 Fe$_3$O$_4$) for each frequency $f$, the value of
$\tan \delta$ as a function of the temperature $T$ shows a
maximum at a temperature $T_{\text{max}}$. The relationship
between $1/T_{\text{max}}$ and $f$ is linear, which suggest an
activation energy (0.11 eV). This effect is not found
when a nickel-zinc ferrite is sintered at 1250 °C,
but it is present when the sintering process takes
place at 1525 °C, when $0.5\%$ of Fe$^{3+}$ ions are formed.
Here too, the activation energy is approx. 0.1 eV.
This leads to the conclusion that the residual losses
in ferrites containing both ferrous and ferric ions
are due to electron diffusion.

2112: G. W. Rathenau: Saturation and magneti-
zation of hexagonal iron oxide compounds
(Rev. mod. Phys. 25, 297-301, 1953)

Review of results formerly published elsewhere
(see Philips tech. Rev. 14, 1952/53 and these
Abstracts No. 2059). The value of the saturation
magnetization at absolute zero of BaO.6Fe$_3$O$_4$
and related compounds can be explained as due to
non-compensated anti-ferromagnetism. The
Bloch wall formation in small particles is dis-
cussed. One is led to the assumption that in
these materials Bloch walls are nucleated at im-
perfections. In specimens containing randomly
oriented large crystals, Bloch wall formation becomes
appreciable at a positive field strength of the order
$4\pi I_s$. By orienting the crystals in a magnetic field
($BH)_{\text{max}}$ values of $3 \times 10^5$ gauss oersted have been
obtained. The critical diameter for wall formation
changes with temperature. An excess of walls
formed at a different temperature from the temper-
ature of measurement may persist in a metastable
equilibrium.

2113: E. W. Gorter and J. A. Schulkes: Reversal
of spontaneous magnetization as a function of
temperature in Li-Fe-Cr spinels (Phys.
Rev. 90, 487-488, 1953)

Néel's theory of non-compensated anti-ferromag-
etism predicts that in some materials the sponta-
neous magnetization should change its sign below the
Curie temperature, since it is the difference between
the anti-parallel magnetizations of the two sublat-
tices, each of which may vary differently with
temperature. This behaviour has been established
for a series of Li-Fe-Cr spinels.

2114: J. S. van Wieringen: Anomalous behaviour
of the g-factor of Li-Fe-Cr-spinels as a func-
tion of temperature (Phys. Rev. 90, 488, 1953)

The g-factor of the spinel mentioned in abstract
No. 2113, which has the value 2 at 0°K, rapidly
decreases above 200°K. Starting from high tempe-
rances (450°K), at which $g$ is likewise about 2,$g$
increases as the temperature is reduced and ap-
proaches infinity at $T = 337°K$. A qualitative
explanation of this behaviour is derived from
Kittel's g-formula and from the change of the
spontaneous magnetisation as a function of tem-
perature.

2115: J. M. Stevels: Le verre considéré comme
polymère (Verres et Réfractaires 7, 91-104,
1953)

Certain properties of silicate-glasses do not depend
on the kind of network-modifying ions, but mainly
on the number of bridging oxygen ions per tetra-
hedron, $Y$, a number which also indicates the num-er of contact points of each tetrahedron: $Y$, there-
fore, is a measure of the internal coherence of the
network. The physical properties of the glass are
very considerably influenced by this internal
coherence of its network: glasses whose $Y$-value
lies between 4 and 3 are mechanically strong and
chemically resistant; at values between 3 and 2 the
glass becomes less and less resistant; if $Y = 2$ chains
of unlimited length occur, held together by the
network-modifying ions, thus constituting an ex-
remely weak lattice, highly susceptible to thermal
and mechanical influences. If $Y$ is smaller than 2,
the length of the chains is no longer unlimited; silicates whose chains possess a high degree of symmetry may crystallize in spite of their great length. The phosphates, on the other hand, having a non-symmetrical structure, may still yield vitreous substances at Y-numbers as low as 1.6. As regards silicates, however, a small disturbance of the symmetry may suffice to prevent crystallisation: similar situations are frequently met in the chemistry of organic polymers. These considerations are confirmed by the examination of the dielectric losses of the glass in a H.F. electric field. At very low temperatures "deformation losses" of the network are found to occur, due to the sudden transition into another position of certain portions of the network chains. As the Y-value of the glass decreases, the deformation losses as a rule become greater, whilst the maximum of these losses as a function of the temperature is shifted to increasingly high temperatures.


A distinction is made between the quantities "dose" (ionising ability, measured in roentgen), and "absorbed dose" (energy imparted by the radiation measured in rads or ergs per gramme). The methods by which both quantities can be measured are analysed. The measurement of dose at photon energies above 3 MeV has not yet been realised. The correlation between dose and absorbed dose is discussed. In air-equivalent or nearly air-equivalent material at moderate photon energies, dose is a fair measure of absorbed dose; in non air-equivalent tissue, the differences in mass absorption coefficient between this tissue and air should be taken into account; at discontinuities in the atomic composition, the increased generation of secondary electrons in materials with higher atomic number will also cause an increased ionization in neighbouring tissues with lower atomic number; at photon energies above 1 MeV there is an increasing discrepancy between dose and absorbed dose at the same place. (In the first-mentioned paper the author used the terms "irradiation" instead of "dose", and "dose" in place of "absorbed dose". The terms used in the second-mentioned paper and in this abstract are those since adopted by the International Commission on Radiological Units.)


Brune's method for the synthesis of two-poles is extended to the synthesis of $2n$-poles. This leads to networks with the minimum number of reactances and the minimum number of elements.

2118: J. I. de Jong and J. de Jonge: Kinetics of the hydroxymethylation of phenols in dilute aqueous solution (Rec. Trav. chim. Pays-Bas 72, 497-509, 1953)

The hydroxymethylation of phenols has been investigated in the pH range 1-11 and between 70-130°C in dilute aqueous solution. The reaction appears to be bimolecular. Below about pH = 4 the rates were found to be proportional to the concentration of the hydrogen ions, while a proportionality to the concentration of the hydroxyl ions was observed in more alkaline solutions. An influence of the concentration of buffers on the rates has not been observed. The presence of small amounts of triethanolamine does not influence the rate of the reaction. The mechanism of the reaction is discussed.


2120: J. I. de Jong: A determination of methylol groups in condensates of urea and formaldehyde (Rec. Trav. chim. Pays-Bas 72, 652-654, 1953)

Methylol groups in condensates of urea and formaldehyde may be determined using an alkaline solution of potassium cyanide. Excess cyanide is back titrated with mercuric nitrate.


Survey of the method developed by the author, of using complete evaporation in the D.C. carbon arc and projection of the spectrum on a standard paper density scale (s.p.d. scale). Some results are compared with those of conventional chemical analysis. See also Philips tech. Rev. 12, 337-348, 1950/51.