RESEARCH ITEMS.

The Gordian Unwinding of Knots —
H Wendt (Die Gordische Auflosung von
Knoten   *Math Zeit*, Bd 42, 680 699) has
investigated the *uberschneidung* number (*i e*,
cross-over number) of knots and has also obtain
ed the connection between it and the cyclic over-
lying manifolds (*zyklische uberlagerungen*) of the
knots (*i e* the outer space of the knots)   He
has also given examples of knots to show that
this number may, in certain circumstances be
greater than the genera (*i e*, *geschlecht*) and *vice
versa* in some circumstances

A knot is a one one continuous transform of
a circle in three dimensional space   In order to
simplify matters the three dimensional euclidean
space in which the knot is placed is conceived so
that it is conceived of as a hyper 3 sphere S_3 in
an euclidean E_4 Two knots are said to be equi
valent if the space containing one of the knots
can be topologically (one one continuous) trans
formed into the other so that the two knots
correspond to each other   In order to simplify
matters still further it is supposed that every
knot can be made equivalent to a knot which
consists of a finite number of straight line bits
On account of this supposition and as every one
dimensional cycle is homolog zero in S_3 we can
have a surface without singularities with the
knot as boundary   The most fundamental and
yet unsolved problem in the theory of knots is
the determination of the complete system of
topological invariants of the open complex $S_3 - k$
(where k is the knot)   A number of these are
known   For some there are methods for calcu
lating them and for some others there are no
methods of calculating them at all although we
easily see that they are invariants   Some of the
important among them are these —(1) *Genera*
Now among the surfaces in S_3 which have k as
the boundary there are those which when they
are canonically represented as a sphere surface
with one one corresponding holes with k as
boundary, the number of such holes is the least
equal to h This is called the genera of the knot
(2) The minimum number of double points of
a projection of the knot on a plane   (3) When
we weave surfaces in S_3 with k as boundary, the
surfaces penetrates itself and the least number
of such penetrations is the Panmwitz Invariant
There is no method as yet of calculating this
for knots   (4) In order to convert a knot into
a circle by means of homotop deformations it is
necessary in general to cross itself   The mini
mum number of such crossings is called the
uberschneidungs zahl   It is obviously zero in
the case of the circle and one in the case of
Ineeblatt schlinge (*i e*, the knot in the ordinary
use)

Wendt concerns himself with this number (for
brevity we use *v* for this number)   For obtaining
his result he connects this with the cyclic over
lying manifolds of the knot (which can all be
calculated—see, *e g*, Seifert Ihelfall *Lehrbuch
der topologie*, ch 8)   He conceives the overlying
manifolds as having been generated by attaching
the requisite number of S_3 k s along a surface
woven into the knot just as we usually consider
a Riemann surface   Considering the homologic

groups of one dimension just before and after
a crossing he obtains the following results —

(1) If $v = 1$, then the one dimensional homo
logie group of the g leaved overlying manifold
(which is branched along λ obviously) is gene
rated by means of $(g - 1)$ elements

(2) A knot cannot be unwound with n cross
ings when the least number of the generators of
the homologie group of the g leaved overlying
manifolds is greater than $n(q - 1)$

Now taking the sum of n *kneeblatt schlinges*, he
shows that it can only be unwound with $(n + 1)$
crossings   In this case $(n + 1)$ is also the genera
of the knot

He has also given examples of knots where
v is $>$ their genera   (The *reverse* case
happens in the case of knots 8_{20} and $9l_{42}$ in the
Alexander Brigg table as pointed out by him,
i e, $v = 1$, and genera is 2^{10})   He gives interest
ing constructions of knots with i being double
their genera

<div align="right">K V I</div>

**On the Asymptotic Values of an Integral
Function —**Grunsky (*Math Zeit*, Bd 42,
674 679) has given an interesting and short
proof of the theorem that the asymptotic values
of an integral function of order p is at most equal
to $2 p$ This conjecture of Denjoy was proved in
part by Carlmann with $5 p$ instead of $2 p$ and
Ahlfors was the first to give a proof by deepen
ing the methods of Carlmann   Another short
proof was given by McIntyre two years ago
Grunsky has first shown easily that if k be *any*
region of area I and ω (z) any function analytic
in it (it may be equal to different functions in
different parts of k) and I is the area of the
Riemann s surface of ω corresponding to k Then

$$II \geqslant A^2, \text{ where } A, = \frac{1}{2i} \int R\,\overline{\omega}\, dL.$$

where R is the boundary of k Then following
almost the usual order of the earlier proofs he
obtains the following sharpening of the Denjoy-
conjecture —

(1) If $f(z)$ [$z - re^{i\theta}$] is an integral function
with k different asymptotic values so is

$$\lim \frac{\text{Log } M(r)}{r^{kl}} > 0$$

(2) If on the asymptotic paths with $Z \to \infty$

$$\text{Lim} \frac{|\theta|}{\text{Log } r} - \lambda > 0, \text{ then}$$

$$\text{Lim} \frac{\text{Log Log } M(r)}{\text{Log } r} \geqslant l/2\,[1 + \lambda^2] \text{ with}$$

the same result for the lower limit with the
corresponding assumption

<div align="right">K. V I</div>

**Determination of the Electronic Charge
by the Oil Drop Method —**The determination of
X ray wave-lengths by the grating method showed

that the value of the charge on the electron should be higher than the value obtained by Millikan Millikan s value, recomputed by Birge was $4\ 768 \times 10^{-10}$ e s u while Bäcklin and Bearden gave $4\ 805$ and $4\ 806$ respectively on the basis of their X ray measurements Recently attempts have been made by Kellstrom, Bond and others to attribute the discrepancy between these values to the inaccuracy of the value of the viscosity of air employed by Millikan The viscosity of air was found to be higher than that used by Millikan, so that Millikan's data together with the new values of the viscosity gave a value for e very near to the X ray value Great interest attaches to the value of e since Eddington's theory of protons and electrons requires that e should be 4 806 Now Y Ishida I Fukushima and T Suetsugu (*Sc Papers Inst Phys & Chem Research Tokyo* 1937 **32,** 57) have repeated Millikan s experiment with various refinements and using the value of the viscosity of air obtained by Harrington (viz $\eta_{15} = 0\ 00018226$ whereas Kellstrom s value is 0 00018348) they find $e = (4\ 806 \pm 0\ 003) \times 10^{-10}$ e s u

The condenser plates of stainless steel 22 cm in diameter and 2 5 cm thickness were placed nearly in the middle of the tank the lower plate being supported by three glass tubes 2 cm in diameter and 5 cm in length and having polished supporting ends This was done to reduce the effect of convection currents on the speed of the oil drops To prevent the evaporation and oxidation (or adsorption) of the oil drops occurring when commercial oils are used a special oil was carefully prepared from animal oil To get rid of the heating effect of the arc a circulating water cell of 70 cm length was used in addition to the ultrazin filter To correct for the shape of the oil drops observations were made only on spherical drops and on spheroidal drops which later on became spherical The temperature of the bath was kept constant to within a few thousandths of a degree The condenser plates separated by quartz prisms of 14 1674 ± 0 0001 cm thickness were charged by a highly insulated lead storage battery of 10000 volts and two ampere hour capacity The voltage varied by 2 volts in 5 hours The time was measured by a Société Genevoise printing chronograph controlled by the Riefler master clock which did not vary more than $\frac{1}{100}$ sec per day The final value obtained was, as stated before, $(4\ 806 \pm 0 \cdot 003) \times 10^{-10}$ e s u

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The Neutrino Theory of Light —Jordan s neutrino theory of light has already been summarised in these columns Fock raised some objections to the theory both of a physical and mathematical nature The mathematical objections have been refuted by Nagendra Nath and others and now Fock accepts the validity of these replies (*Comptes Rendus, Acad Sciences,* URSS 1937 **15** 241), but reaffirms that the physical objection raised by him is still valid His objection is that the quantum number distinguishing between neutrinos and antineutrinos plays an essential part in the theory, while such a distinction is not physically possible since the

neutrinos and antineutrinos have both zero charge and the same mass and spin Louis de Broglie also considers that Jordan's theory of pairs of unconnected neutrinos giving rise to optical phenomena which are only apparently attributable to quanta, cannot be upheld (*Annales de la Société Scientifiques de Bruxelles* 1937, **57,** 99) He prefers his own theory which considers a quantum as a real entity formed from two particles obeying Dirac s equation His objections to Jordan's theory are as follows —

(1) The theory of Jordan has found admirers because it succeeds in deducing Bose statistics for quanta from the Fermi statistics obeyed by the neutrinos But to have one mechanism for deriving the Bose statistics for composite particles like the α particles from the Fermi statistics valid for the component elementary particles, and to have an entirely different mechanism for quanta is not, in his opinion, a very satisfactory procedure

(2) If one assumes that a swarm of neutrinos, all of the same energy $h\nu_m$, passes through a screen having a resonance frequency ν lying between $\frac{\nu_m}{2}$ and ν_m the effect to be expected according to Jordan s theory is contrary to experiment For the swarm of neutrinos of energy $h\nu_m$ gives rise by their Raman effect to the appearance of a continuous radiation having frequencies lying between 0 and ν_m After passing through the screen however they have energies equal to $h\nu_m - h\nu$ and thus correspond to a continuous radiation of frequency lying between 0 and $\nu_m\ \nu$ (which is $< \nu/_2$) Thus the passage through the screen should according to Jordan's theory lead to a cutting off of the radiation beyond $\nu_m - \nu$, whereas what is actually observed is only an absorption line at ν

(3) The diffraction effects observed with quanta of frequency ν correspond to an actual frequency ν and it is difficult to see why neutrinos having no such single frequency should give rise to such effects

(4) The law of rectilinear propagation of light has been verified up to astronomical distances It is difficult to see why pairs of neutrinos which do not form a composite particle should be simultaneously emitted so accurately in one direction

The objections raised by Fock and de Broglie provide much material for careful consideration

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Diabetic Ketosis — Prof Szent Györgi s latest discovery arising from his studies of tissue metabolism, concerns the use of succinic acid as a remedy for ketosis of diabetes (*Lancet,* 1937 **233** 200) Only five patients have so far been treated but in one of them it was found that as little as 1 0 gm daily by mouth would remove ketosis the acetone bodies disappearing completely from the urine and the alkali reserve rising Accord ing to Szent Gyorgi the respiration of tissues is catalysed by certain C_4 dicarboxylic acids, of which succinic acid is one Pyruvic acid in particular, which is an intermediary substance in carbohydrate metabolism is catalysed by these C_4 acids If for some reason the catalysis fails, pyruvic acid is not oxidised but is instead converted into acetone bodies He suggests that

ketosis of diabetes is due to failure of the C_4 acids to catalyse the oxidation of pyruvic acid, this failure probably being due to shortage of C_4 dicarboxylic acids in diabetes, either because their formation is inhibited or because their destruction is accelerated "

Sugarcane-Bamboo Hybrids—Remarkable results have been obtained by Rao Bahadur T S Venkatraman, in his work on the intergeneric hybridization between sugarcane and bamboo—*Bambusa arundinacea* (*Ind Jour Agri Sci* 1937 **7**, 513) ' Success in sugarcane breeding depends largely on the extent of variation which it is possible to induce in the seedlings raised and it was felt that the bringing in of other *genera* (other than *Sorghum Durra* Stapf) might increase the range of such variation and perhaps also open out new lines of advance The first attempt to effect a cross between sugarcane and bamboo which on a previous occasion was given up, was renewed in December 1936

On the sugarcane side the parents employed were the two Java canes, POJ 213 and POJ 2725 these were the only varieties available for crossing at the time December being practically the end of the cane flowering season at Coimbatore Both these canes have little fertile pollen of their own but set seed profusely when cross pollinated with other cane varieties POJ 2725 was the cane which was first used in the intergeneric hybridization with sorghum The bamboo pollen employed was that of *Bambusa arundinacea* Willd from Madras, the few available inflorescences being railed to Coimbatore in special receptacles The attempt has yielded twenty nine hybrids—eighteen with POJ 213 and eleven with POJ 2725, as mother parent "

' Though even from the very early stages these hybrids displayed characters not previously noticed in sugarcane seedlings during almost a quarter century of sugarcane hybridization at Coimbatore, this announcement was delayed till the plants showed definite and clear bamboo characters These have since been found in the mode of underground branching, nature of shoot and bud formation central cavity in the stem anatomical characters of the stem and root and number of chromosomes '

' It is well known that sugarcane seedlings display considerable variations among themselves in the F_1 generation The present batch of twenty nine hybrids show similar variations and different bamboo characters are showing themselves in different plants They further show abnormalities even more numerous than those met with in the intergeneric cross with sorghum "

A View of Magmatic Differentiation—C N Fenner in a paper at the Tercentenary Conference of Arts and Sciences at the Harvard University (*Journ Geol* **45**, No 2) has pointed out certain difficulties in the way of the theory of differentiation by crystal fractionation He doubts whether the results of the laboratory experiments can be applied to silicate melts at great depths His observations at many places have shown successive outpourings of rhyolite and basalt, without any intermediate members From this and from the undoubted examples in Alaska where acid rhyolites have assimilated very basic rocks in contravention to the well known principle of Bowen he believes that crystal fractionation cannot be accepted universally to explain the diversity in igneous rocks

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The Water Content of Magmas—In the evolution of the different igneous rocks some petrologists have attributed a large influence to the water content of the magmas whereas others have assigned a very minor part to it This is partly due to the fact that the actual percentage of water in different magmatic bodies is not definitely known and in most cases it is estimated to be not more than about two per cent James Gilluly (*Am Jour Sci* **33** No 198) basing his arguments on the assumption that the hydrosphere is the result of original differentiation of basalt inclines to give a much higher percentage of water content to magmas Most of the analyses of the igneous rocks do not show the actual water content but represent only the minimum quantity Working on Daly's assumption of the density stratification of the Earth, Gilluly has estimated that there is as much as four per cent of water in basalts and eight per cent in granites

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The Urinogenital System of the Male Indian Elephant.—T L Schulte (*Amer Journ Anat*, May 1937, **61**, 1) has described the kidneys and testis of *Elephas indicus* along with their ducts The kidney is not divisible into cortical and medullary regions in the adult They have no papillæ but two to four shallow depressions, each at the apex of the pyramid receiving the collecting tubules emptying into each minor calyx There is no renal plexus, the tubes which form a major calyx joining the ureter The testes are abdominal and permanently fixed Their secretion which was creamy white had nonmotile sperms and its specific gravity was the same as that of urine It had an alkaline reaction