

FAUST

E I N E H I S T O R I E

MANUSCRIPT AFTER: J. W. von Goethe
PRODUCED BY: The Task Force of the
"Institute for Theoretical Physics,"
Copenhagen



Motto:

Not to criticize . . .

N. Bohr

PROLOGUE

Between Heaven and Hell

PREFATORY REMARKS

The early decades of the present century witnessed the heady development of the Quantum Theory of the atom, and during that era the roads of theoreticians of all nationalities led, not to Rome, but to Copenhagen, the home city of Niels Bohr, who was the first to formulate the correct atomic model. It became customary at the end of each spring conference at Blegdamsvej† 15 (the then street address of Bohr's Institute of Theoretical Physics) to produce a stunt pertaining to recent developments in physics. The 1932 conference, which coincided with the tenth anniversary of Bohr's Institute, followed closely on the British physicist James Chadwick's discovery of a new particle *having the same mass as a proton but deprived of any electric charge*. Chadwick called it the *neutron*, the name which is now familiar to anybody interested in nuclear physics and in what is called, somewhat incorrectly, "atomic energy."

But there was some mixup in terminology. A few years earlier Wolfgang Pauli used the same name for a hypothetical particle which *had no mass and no charge* and was, in his opinion, necessary to explain the violation of the Law of Conservation of Energy observed experimentally in the processes of radioactive Beta-decay. "Pauli's Neutron" was the subject of hot discussions among the physicists, but these discussions were exclusively oral or carried on by private corre-

† Pronounced "Bli-dams-vi."

spondence, and the name was never "copyrighted" through appearance in any publication. Thus, when the discovery of Chadwick's heavy neutron was announced in his 1932 paper in *Nature*, the name of Pauli's weightless neutron had to be changed. Enrico Fermi proposed calling it the *neutrino*, which in Italian means a little neutron. In the following translation the name of Pauli's "neutron" in the original text is changed to the present name "neutrino," the existence of which had not at that time been demonstrated. Many physicists, especially Paul Ehrenfest, of Leiden, were very skeptical concerning Pauli's hypothetical neutrino, and it was only in 1955 that its existence was indisputably proved by the experiments of Fred Reines and Cloyd Cowan, of the Los Alamos Scientific Laboratory.

The pages that follow are the script of a play that was written and performed by several pupils of Bohr and staged at the spring meeting in 1932. (The author of this book was unable to participate in the play, the Soviet Russian Government having refused him a passport to attend the Copenhagen meeting.) The theme of this dramatic masterpiece has Pauli (*Mephistopheles*) trying to sell to the unbelieving Ehrenfest (*Faust*) the idea of the weightless neutrino (*Gretchen*).

The Blegdamsvej *Faust*, rendered into English by Barbara Gamow, is reproduced in this book as an important document pertaining to these turbulent years in the development of physics. The authors and the performers prefer to remain anonymous, except for J. W. von Goethe. Because of our failure to locate the original author or authors and the original artist, we are suggesting that the publisher deduct an appropriate moiety of the royalties which are to be paid, and hold this amount in escrow for a period of two or three years in the hope that the publication of the book may lead

to the discovery of the author and/or artist. Failing that, the sum of money could be presented to the Institute's Library for the acquisition of new books.

Thanks are due to Professor Max Delbrück for his, kind help in the interpretation of certain parts of the play.

G.G.

In the German text of this physics Faust, Goethe's rhythms and rhyme schemes (see comparable passages in the original Faust) were followed closely but not exactly. Certain poetic license has been taken here too, with the result that this English version falls somewhere between the other two. Unfortunately, some of the lines from the original Faust, which were used verbatim in the German physics version, could not be used here. Also, there were a few puns in the German language for which it was necessary to attempt English substitutions. Some of the passages in prose in the German physics version have here been converted into verse and appear as speeches by the Master of Ceremonies. This was with the idea of making this Faust more playable on the stage.

There is an amusing confusion of identity throughout: Gretchen is at times referred to as Gretchen and at other times as The Neutrino; Faust sometimes as Faust and at other times as Ehrenfest. But it all adds to the fun, and nobody's the worse for it.

And by the way, if this should be played on the stage, it would seem a good idea for the different minor characters (be they Human or Physical Concepts) to wear signs indicating who they are: "Slater," "Darwin," "The Monopole," "The False Sign," etc. Otherwise, the audience will be hopelessly muddled.

B.G.

WHOM THE CHARACTERS REPRESENT

(Note: the Master of Ceremonies is played by Max Delbrück, German physicist)

ARCHANGEL EDDINGTON	A. Eddington, British astronomer
ARCHANGEL JEANS	J. Jeans, British astronomer
ARCHANGEL MILNE	E. A. Milne, British astronomer
MEPHISTOPHELES	W. Pauli, German physicist
THE LORD	Niels Bohr, Danish physicist
THE HEAVENLY HOSTS	"Extras"
FAUST	P. Ehrenfest, Dutch physicist
GRETCHEN	The Neutrino
OPPIE	R. Oppenheimer, American physicist
A TALL MAN	R. C. Tolman, American physicist
MILLIKAN-ARIEL	R. A. Millikan, American physicist
LANDAU (DAU)	L. Landau, Russian physicist
GAMOW	G. Gamow, Russian physicist
SLATER	J. C. Slater, American physicist

DIRAC	P. A. M. Dirac, British physicist
DARWIN	C. Darwin, British physicist
FOWLER	R. H. Fowler, British physicist
FOUR GRAY WOMEN	The Gauge Invariant, Fine Structure Constant, Negative Energy, Singularity
FRIENDLY PHOTOGRAPHER	A friendly photographer
WAGNER	J. Chadwick, British physicist
MYSTICAL CHORUS	Everybody who can sing

The Blegdamsvej

Faust



***The* THREE ARCHANGELS, THE LORD, THE HEAVENLY
HOSTS, *and* MEPHISTOPHELES**



ARCHANGEL EDDINGTON

As well we know, the Sun is fated
In polytropic spheres to shine;¹
Its journey, long predestinated,
Confirms *my theories* down the line.

Hail to *Lemaître's* promulgation²
(Which none of us can understand)!
As on the morning of Creation
The brilliant Works are strange and grand.

ARCHANGEL JEANS

And ever speeding and rotating,
The double stars shine forth in flight,
The Giants' brightness alternating
With the eclipse's total night.

Ideal fluids, hot and spinning,
By fission turn to pear-shaped forms.⁸
Mine are the theories that are winning!
The atom cannot change the norms.

ARCHANGEL MILNE

The storms break loose in competition
(The *Monthly Notices* as well!)⁴
And burn with violent ambition
Important tidings to foretell.

At heat of 10 to 7th power
The gas degenerates in flame,
Permitting us our shining hour
Of freest flight in *Fermi's* name.⁵

THE THREE

This vision fills us with elation
(Though none of us can understand).
As on the Day of Publication
The brilliant Works are strange and grand.

MEPHISTO

(*springing forward*)



Since you, O *Lord*, yourself have now seen fit
To visit us and learn how each behaves,

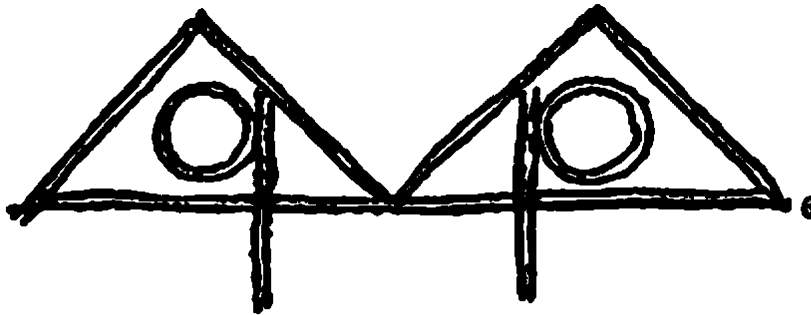
And since it seems you favor me a bit,
Well—now you see me here

(turning to the audience)

among the slaves.

On Stars and Worlds I've nothing for the jury,
All that I know is how the folks complain.
To me the theory's full of sound and fury,
Yet here you are in ecstasy again,
Approving views that shatter like a bubble,
Sticking your nose in every kind of trouble.

THE LORD



But must you interrupt these revels
Just to complain, you Prince of Devils?
Does Modern Physics never strike you right?

MEPHISTO

No, Lord! I pity Physics only for its plight,
And in my doleful days it pains and sorely grieves
me.

No wonder I complain—but who believes me?

THE LORD

You know this *Ehrenfest*? . . .

MEPHISTO

The Critic?¹

(A vision of the above appears)



THE LORD

My knight!

MEPHISTO

Your knight, your slave and henchman. What's your bet?

You still will lose, I warn you, if you let
Me tempt this knight and lead him far astray.

THE LORD

Oh, this is really dreadful! Must I say . . .
Jah, muss Ich sagen. . . . There is an essential⁸
Failure of classic concepts—a morass.
One side remark—but keep it confidential—
Now what do you propose to do with *Mass*?

MEPHISTO

With *Mass*? Why, just forget it!

THE LORD

But . . . but this . . .
Is very in-ter-est-ing. Yet to try it . . .

MEPHISTO

Oh, *Quatsch!* What rot you talk today! Be quiet!

THE LORD

But . . . but . . . but . . . but . . .

MEPHISTO

That's my hypothesis!

THE LORD

But *Pauli*, Pauli, Pauli, we practically agree.
There's no misunderstanding—that I guarantee.
Natürlich, Ich bin einig. We might throw *Mass* away
But *Charge* is something different—why *Charge* just
has to stay!

MEPHISTO

What temperamental nonsense! Why *not* get rid of
Charge?

THE LORD

I understand completely, but *maa jeg spørge*,
friend,⁹

MEPHISTO

Shut up!

THE LORD

But Pauli, surely you'll hear me to the end?
If *Mass* and *Charge* go packing, what have you, by
and large?

MEPHISTO

Dear man, it's elementary! You ask me what remains?
Why bless me, The *Neutrino!* Wake up and use your
brains!

(Pause. Both pace to and fro)

THE LORD

I say this not to criticize, but rather just to
learn. . . .¹⁰

But now I have to leave you. Farewell! I shall return!

(He exits)



MEPHISTO

From time to time it's pleasant to see the dear Old
Man,

I like to treat him nicely—as nicely as I can.

He's charming and he's lordly, a shame to treat him
foully—

And fancy!—he's so human he even speaks to Pauli!

(He exits)

FIRST PART

Faust's Study



FAUST

I have—alas—learned Valence Chemistry,
Theory of Groups, of the Electric Field,
And Transformation Theory as revealed
By Sophus Lie in eighteen-ninety-three.

Yet here I stand, for all my lore,
No wiser than I was before.

M. A. I'm called, and Doctor. Up and down,
Round and about, the pupils have been guided
By this poor errin' Faust and witless clown;
They break their heads on Physics, just as I did.
But still I'm better than the cranks,
The Big Shots, monkeys, mountebanks.

All doubts assail me; so does *every* scruple;
And Pauli as the Devil himself I fear.

I grab the eraser, like a frantic pupil,
Before the magic X-ings disappear,¹¹
For what is written down on black, in white,
Is apt to be acceptable and right.

Du Lieber Gott! I still could do some teaching.
I have no *Guth* nor *Breit* here at my side,¹²
But I could use their aptitude for preaching
To spread the tested gospel *good* and *wide*.

Not even *Hund* nor *hound* could bear my lot,¹⁸
So I'm The Critic, sad and misbegot.

(MEPHISTO *bursts in*
like thunder, dressed as
a traveling salesman)



Why all the noise?

MEPHISTO

I'm at your service, Sir!

FAUST

What do you take me for? A customer?

MEPHISTO

You used to be receptive and urbane. . . .
These theories nowadays are wrong as rain;
Therefore I want to show you something higher,
For with it you can set the world on fire:
"The Dance of the Golden Calf"—kaleidoscopic—
The Radiation Theory is my topic.



(Canon, sung by all)

Born–Heisenberg

Heisenberg–Pauli

Pauli–Jordan

Jordan–Wigner

Wigner–Weisskopf

Weisskopf–Born

Born–Heisenberg¹⁴ *(etc.)*

(etc.)

MEPHISTO

These are my own,

Bone of my bone.

Listen how, with spunk and spice,

Precociously they give advice.

Here the width of lines diverges

In the wave-field's vasty length.

(The MASTER OF CEREMONIES protests by gesture;

MEPHISTO repeats)

Here the width of lines diverges

In the wave-field's loss of strength.

FAUST

Enough! You'll not seduce me. I am cured.

I'll never touch your reprints, rest assured.

MEPHISTO

I'm glad of that.

(aside)

(His argument has pith.

The first old man that I can reason with!)

(showing his wares)

A Psi-Psi Stern?¹⁵

FAUST

No sale!

MEPHISTO

A Psi-Psi Gerlach?

FAUST

No sale!

MEPHISTO

Electrodynamics?

FAUST

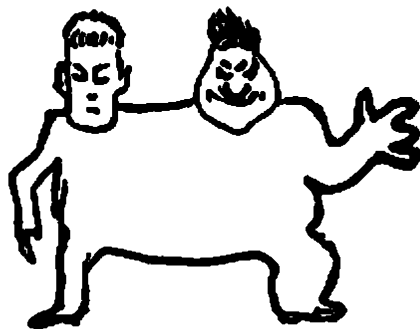
No sale!

MEPHISTO

By Heisenberg-Pauli?

FAUST

No sale!



MEPHISTO

With infinite self-energy?

FAUST

No sale!

MEPHISTO

Electrodynamics?

FAUST

No sale!

MEPHISTO*By Dirac?***FAUST****No sale!****MEPHISTO****With infinite self-energy?****FAUST****The same old story!****MEPHISTO****So I must show you something that's unique!****FAUST****You'll not seduce me, softly though you speak.****If ever to a theory I should say:****"You are so beautiful!" and "Stay! Oh, stay!"****Then you may chain me up and say goodbye—****Then I'll be glad to crawl away and die.****MEPHISTO****Beware alone of Reason and of Science,****Man's highest powers, unholy in alliance.****You let yourself, through dazzling witchcraft, yield****To all temptations of the Quantum field.****Listen! As now the obstacles abate,****You'll know the fair *Neutrino* for your fate!**

GRETCHEN

(comes in and sings to FAUST. Melody: "Gretchen at the Spinning Wheel" by Schubert)



My Mass is zero,
My Charge is the same.
You are my hero,
Neutrino's my name.

I am your fate,
And I'm your key.
Closed is the gate
For lack of me.

Beta-rays throng¹⁶
With me to pair.
The N-spin's wrong¹⁷
If *I'm* not there.



My Mass is zero,
My Charge is the same.
You are my hero,
Neutrino's my name.

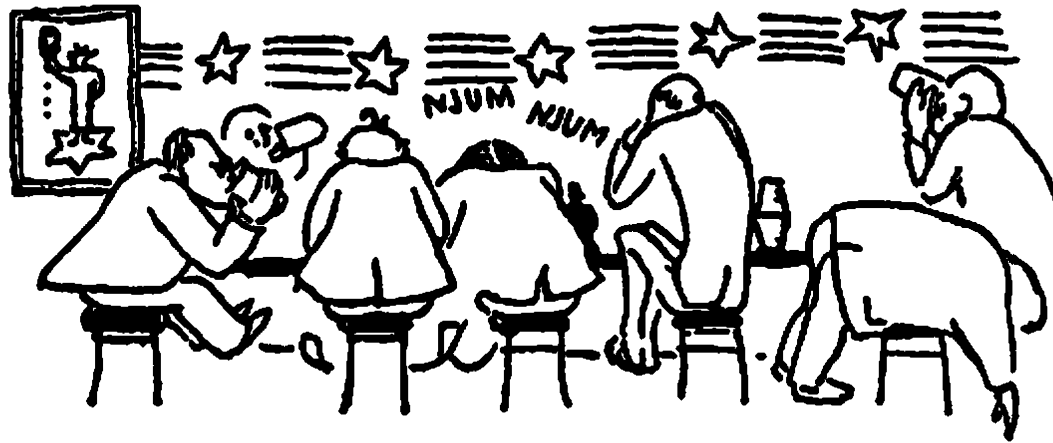
My psyche turns
To you, my own.
My poor heart yearns
For you alone.

My lovesick soul
Is yours to win.
I can't control
My trembling spin.

My Mass is zero,
My Charge is the same.
You are my hero,
Neutrino's my name.

(Exeunt omnes)

MRS. ANN ARBOR'S SPEAKEASY¹⁸
(otherwise known as Auerbach Keller)
(American physicists sitting sadly at the Bar)



MEPHISTO

(springing forward behind the bar)



**Can no one laugh? Will no one drink?
I'll teach you Physics in a wink. . . .**

**(he winks exaggeratedly and knowingly at the
physicists)**

**Shame on you, sitting in a daze
When as a rule you're all ablaze!**

OPPIE

(swallowing—Njum! Njum!—before speaking)

Your fault! You've brought no single word of cheer—
No news, no X-ings. Bah!

MEPHISTO

(producing GRETCHEN)

But both are here!



(Lively applause and general tumult)

A TALL MAN

A shapely and appealing Signorina. . . .

(to MEPHISTO)

But tell me, have you been in Pasadena?

MEPHISTO

With *Einstein*, yes. He greets you in your harbor,
This *wunder*-bar of Mrs. Annie Arbor.

A TALL MAN

Einstein! His curves! His fields! His whole arena!

MEPHISTO

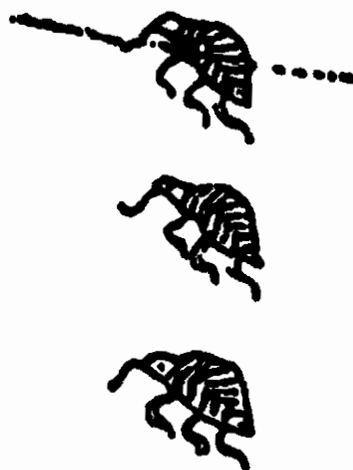
(sings)

A *Monarch* cherished dearly
 A *Flea*, just as a son,¹⁹
 And quite as much—or nearly—
 As Gra-vee-táy-shee-un.

The Monarch summoned *Mayer*,²⁰
 Said Mayer: "To be sure!
 I'll make him tensors, Sire,²¹
 With junker curvature."



Attired as a dandy,
 The Flea was then displayed.
 Folks ate him up like candy
 So sweetly was he made.



The Flea grew up, and later
 His *Son* was born. The son²²
 Kept challenging his pater
 But never got to run.

$$\underline{\Gamma}_{st}^i = \Gamma_{st}^i + \Gamma_{st,r}^i \otimes r$$

$$\int \mathcal{M}_i \otimes^i d\tau$$

$$\mathcal{G}^{\text{is}} \nabla_s = 0$$

Half-naked, fleas came pouring
 From Berlin's joy and pride,
 Named by the unadoring:
 "Field Theories—Unified."

Now, Physicists, take warning,
 Observe this sober test. . . .
 When new fleas are a-borning
 Make sure they're fully dressed!

ALL

Drunk though we are, we feel as fine
 As—hic!—five hundred female swine!

FAUST

(known to be opposed to alcohol, steps forward and sings)



(to MEPHISTO)

Do you expect me to get well
In all this chaos, din and hell?

(to GRETCHEN)

You Skeleton, you Monster, here I stand,
But do you recognize your lord and master?
What holds me back? See here, I take your hand
And *shatter* you!

GRETCHEN

Faust, Faust, I fear disaster!

(*Exeunt omnes*)

SECOND PART

A Charming Region

**(FAUST sleeps, on a bed of roses. A plum tree grows,
to the right. A terrific din announces the approach of
the MILLIKAN-ARIEL)**



MILLIKAN-ARIEL

(from above)

**Hear, oh hear the words of rubes
(Wilson Chambers, Counting Tubes)!²³
Thundering, for the spirit's ear,
Cosmic Rays will now appear!
The protons are creaking and chattering,
Electrons are rolling and clattering.
Light comes rushing—whither? whence?
Heisenberg is really grumpy;²⁴
Rossi, Hoffmann—both are jumpy.²⁵
All this nonsense makes no sense!**



FAUST

(awakening)

Sweet rosy field—what soil am I caressing?
And why familiar? *Rosenfeld*, they say,²⁶
To the greengauge invariant gives a blessing.²⁷
This is his plum.

(MASTER OF CEREMONIES appears)

(to the M.C.)

What's going on today?

M.C.

Walpurgis Nights: the *Classical Poetical*,
And afterwards, the *Quantum Theoretical*.

FAUST

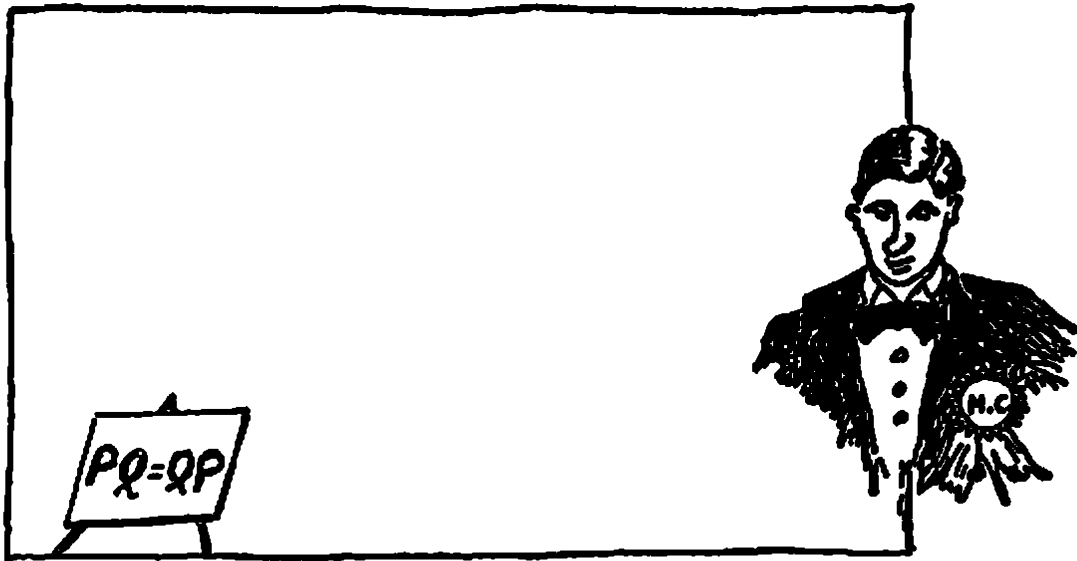
Excellent! I quite agree!

THE CLASSICAL WALPURGIS NIGHT

M.C.

(makes a gesture of presentation)

The Classical—a potpourri!



FAUST

(He leans forward, expecting. A long pause indicates that nothing is happening)

But nothing's happening!

M.C.

Just wait and see!

FAUST

(He waits. Another long pause and again nothing happens)

See here now, Delbrück! . . .

M.C.

**Faust, you must expect
That with the Classical there's no effect
Upon the audience.**

(DIRAC enters)

DIRAC

Correct! Correct!

FAUST

Why not skip this, and go to the Q.-T.?

M.C.

If we do that, I fail as an M.C.,
For first the Classical must duly close.

FAUST

I have two different time-scales to propose
For these Walpurgis Nights. As I've avowed,
The First should go to limbo.

DIRAC

Not allowed!

FAUST

I then propose the Classical be moved
Much farther back in time and place.

M.C.

Approved!

THE QUANTUM THEORETICAL WALPURGIS NIGHT

*(At one side of the stage, to the back, THE LORD and
LANDAU²⁸ appear, the latter bound and gagged)*



THE LORD

Keep quiet, *Dau!* . . . Now, in effect,
The only theory that's correct,
Or to whose lure I can succumb
Is

LANDAU

Um! Um-um! Um-um! Um-um!

THE LORD

Don't interrupt this colloquy!
I'll do the talking. *Dau*, you see,
The only proper rule of thumb
Is

LANDAU

Um! Um-um! Um-um! Um-um!

*(At the other side of the stage, to the back, appears
the face of GAMOW, through bars)*



GAMOW

I cannot go to Blegdamsvej
(Potential barrier too high!).
This "conversation" is the hoax—
The Lord, he really make the joke.
Bounded and gaggled, mouse to toe,
Dau can't say "*Nyet!*" nor "*Horoshol!*"

M.C.

(center stage)

Be careful! *Achtung!* Watch it! These *Holes* of P.
Dirac²⁹
Can trip you in a second and flip you on your back!
(He puts up a "Warning!" sign)

THE MONOPOLE

(steps forward and sings)

Two Monopoles worshiped each other,³⁰
And all of their sentiments clicked.
Still, neither could get to his brother,
Dirac was so fearfully strict!



(to the M.C.)

But tell me—(Watch it! There's a Hole!)
Where is my darling *Antipole?*

M.C.

(aside)

(A Hole! My foot! More like a crater!)

(to the MONOPOLE)

Now just a minute—Here comes Slater.

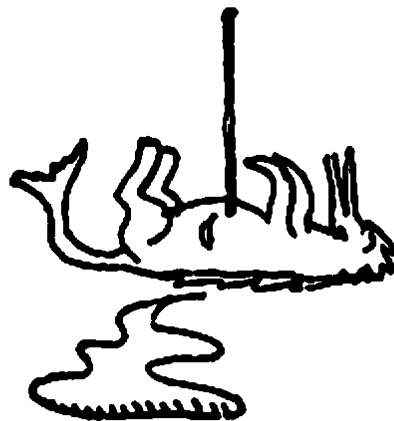
(SLATER steps forward with a bloody lance and THE GROUP DRAGON)³¹



M.C.

(observing the characters running about on the stage)

Why do they run? Why does he roll?
 Who stabbed him with the bloody pole?
Group Dragon, by this mortal blow
 We laid you low!



Scaly with indices is he
 Who died of Anti-symmetry.

Reduced to nothing, there he lies
 Stripped of his status and disguise.
 Group Dragon, by this mortal blow
 We laid you low!

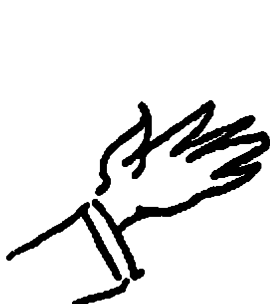
(The FALSE SIGN steps forward)



FALSE SIGN⁸²

All the theories expire or bring disappointment.
The Sign is forever the fly in your ointment.
 The reckoning's splendid and everything's fine—
 Nonetheless, at the zenith, in squeezes *The Sign*!

(DIRAC and DARWIN are brought forward)



M.C.

Now here's the revered *One-dimensional Case*;
 His name is *Dirac*—you remember his face.
Three-dimensional Darwin is following next.

(The FALSE SIGN prances around DIRAC and pulls him to the side. But he has no access to DARWIN)

Observe the False Sign; he's annoyed and perplexed.
 This injures his pride. He can handle Dirac,
 But Darwin's a nut that he can't seem to crack,
 For Darwin so far is like pie in the sky—
 He's only a glint in a physicist's eye.

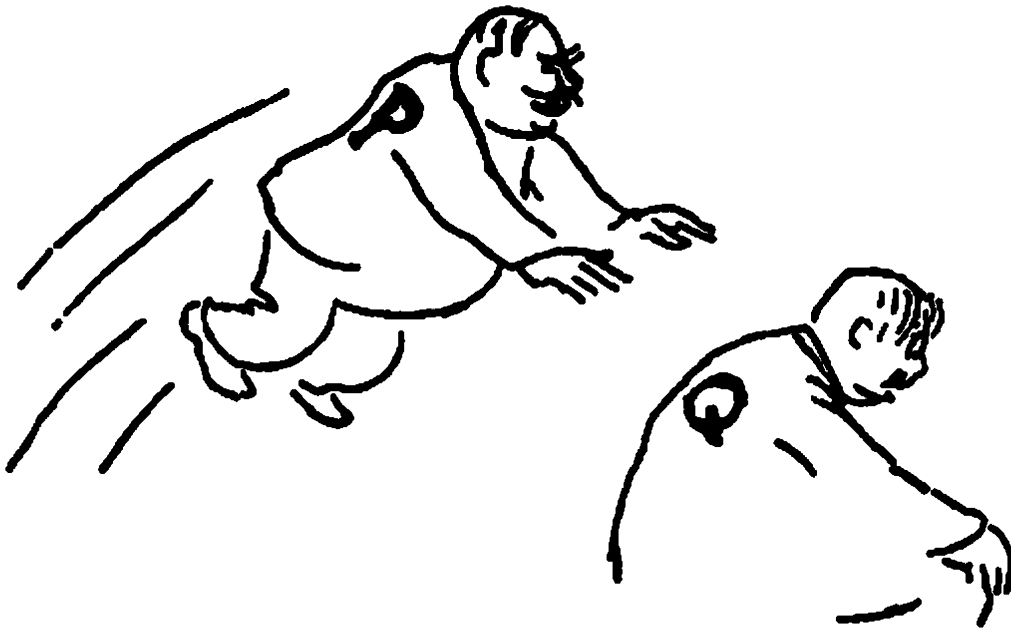
(M.C. holds up a card that reads)

THE EXCHANGE RELATION⁸⁸
 $PQ - QP = h/2\pi i$

Watch this! Darwin's turned himself into a *P*,

(FOWLER arrives on the scene)

And *Fowler*—he's *Q*—has arrived. As you'll see,
 They explain the *Relation* described on the card
 By leapfrogging madly all over the yard.



(At each exchange flashes the sign " $h/2\pi i$." With this goes a song):

Thus exchanged are *P* and *Q*

Time and time anew,

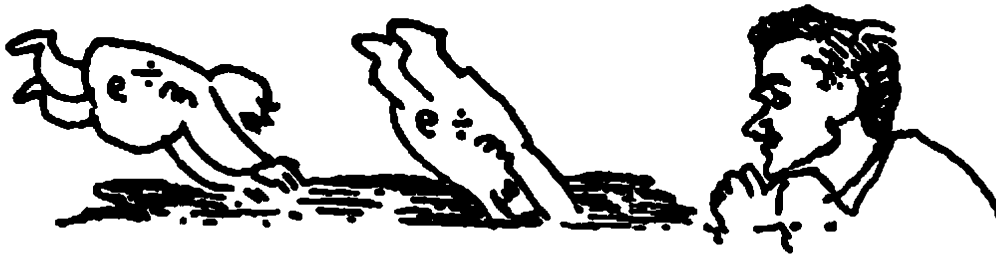
Time and time anew.

Still there ever hovers by:

$h/2\pi i$, $h/2\pi i$!



They can never rest in peace
 Till they're gone as geese,
 Till they're gone as geese.
 Still there ever hovers by:
 $h/2\pi i, h/2\pi i!$



Attention! Attention! Their form is now altered

(P and Q now suffer the painful metamorphosis into DONKEY-ELECTRONS and fall into one of Dirac's Holes)

To *Donkey-electrons*. Observe that they've faltered⁸⁴

And fallen, through carelessness (clumsy old chaps!),

Into one of those Holes that are planted as traps.

(The SPIN OF THE PHOTON, dressed in Indian guise, slithers across the stage, accompanied by fugitive music)



Attention again! Here's *The Spin of the Photon*⁸⁵

With some kind of Indian *sari* and coat on.

(It's clear that no modest, respectable *Boson*⁸⁶

Would traverse the platform without any clo'es on!)

(DIRAC comes forward, followed by FOUR GRAY WOMEN)

THE FIRST

The *Gauge Invariant* is my name.

THE SECOND

I'm of *Fine Structure Constant* fame.⁸⁷

THE THIRD

Negative Energy—that's me.⁸⁸

THE FOURTH

(to THE THIRD)

Just watch your grammar, Number Three!

(to the others)

Sisters, into the reckoning

You cannot and you may not spring.

But in the end there I shall be,

For I am *Singularity*!⁸⁹

(THE FOUR stand to the side of the stage, to mingle in again later)

FAUST

Four I saw come, one I saw go;

And what they tried to say I do not know.

The air is now so full of shades and spooks

That we had best hang on to our perukes.

DIRAC

A strange bird croaks. It croaks of what? Bad luck!

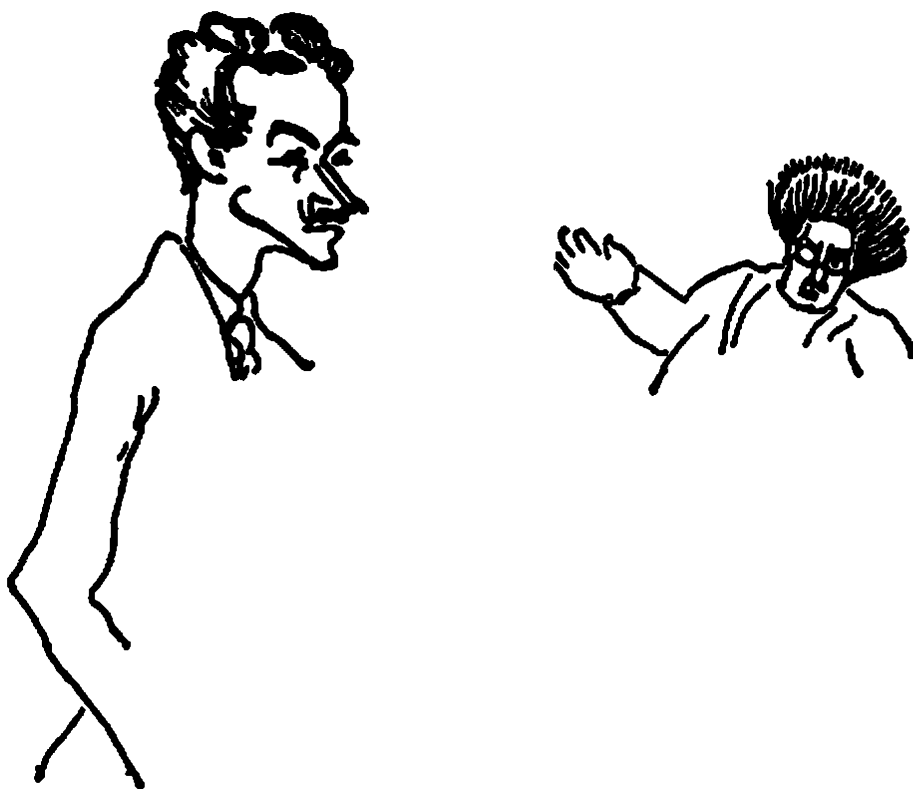
Our theories, gentlemen, have run amuck.

To 1926 we must return;⁴⁰

Our work since then is only fit to burn.

FAUST

Then nothing should originate today?



DIRAC

(to the FOURTH GRAY WOMAN)

You, Singularity, just *go away!*

THE FOURTH

My place is here—and, if you please, *don't shout!*

DIRAC

Wench, through my magic I will get you out!

THE FOURTH

Am I not in Eigen fields?

Does Radiation not contain me?

My form to change forever yields,

My power is such that none can chain me.

Yet on the track, as on the waves,

I stand among the frightened slaves,

Always found, though never sought,

Cursed before she's even caught.

DIRAC

I don't see your point!

(He exits, chased by SINGULARITY)

M.C.

(to DIRAC's back)

You'll see it soon—
That woman's going to chase you to the Moon!

(to the audience)

Unless, of course, his long legs save the day.
Three guesses! Will he make his getaway?

*(MEPHISTO appears. Somebody knocks at the door.
A FRIENDLY PHOTOGRAPHER looks questioningly in-
side.)*



MEPHISTO

Come on, come on! Come in, come in!
You baggy-trousered lout, you,
With plate and film and click and din!

(pointing to FAUST)

He shrivels up without you.

FAUST

(Highly excited, he takes a pose for the press photographer)

To this fair moment let me say:

"You are so beautiful—Oh, stay!"

A trace of me will linger 'mongst the Great,

Within the annals of The Fourth Estate.

Anticipating fortune so benign,

I now enjoy the moment that is mine!

(He dies, and his body is carried out by the Press)

MEPHISTO

No pleasure was enough; no luck appeased him.

The changing forms he wooed have never pleased
him.

The poor man clung to those who would evade him.

All's over now. How did his knowledge aid him?

M.C.

(to the photographer's camera)

Out, Light overpowering!—

Magnesium-devouring,

Thundercloud-showering,

Ego-deflowering,

Stinking One,

Blinking One,

Vex us no more!

FINALE

Apotheosis of the True Neutron

WAGNER⁴¹

(appears, as the personification of the ideal experimentalist, balancing a black ball on his finger, and says, with pride)



The *Neutron* has come to be.
Loaded with Mass is he.
Of Charge, forever free.
Pauli, do you agree?



MEPHISTO

That which experiment has found—
Though theory had no part in—
Is always reckoned more than sound
To put your mind and heart in.
Good luck, you heavyweight Ersatz—⁴²
We welcome you with pleasure!
But passion ever spins our plots,
And Gretchen is my treasure!

MYSTICAL CHORUS

Now a reality,
Once but a vision.
What classicality,
Grace and precision!
Hailed with cordiality,
Honored in song,
Eternal Neutrality
Pulls us along!

