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German Astronomy during the War

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I Introduction

In Germany a fair amount of astronomical research has been carried out during the war, of which the solar research is the most conspicuous. A number of new solar observatories were built, one at Göttingen and four in the Alps. The work at the Potsdam, Babelsberg, Hamburg, Heidelberg, and Munich observatories continued, though on a diminished scale, and also the work at the Rechen-Institut.

During 1944 and early 1945 some of the eastern German observatories were evacuated while others (Leipzig, Munich, and Königsberg) were severely damaged or destroyed. Recently astronomical research has been resumed on a limited scale in a few institutions, but because of the great material destruction in Germany and the drastic reduction in tax income it may be expected that the volume of work produced in the near future will be small.

The principal data of this article are arranged by institutions. Most of the information was obtained in personal visits during the period April-September, 1945. Some observatories were visited more than once; in general the "epoch" of the information is about September, 1945.

References to the astronomers' political activities and attitudes are omitted here, though they should eventually determnie post-war relations. For the same reason the position of the Astronomische Gesellschaft is not discussed here. A few general remarks are found in section V.

II Astronomisches Rechen-Institut

The Rechen-Institut corresponds to the U. S. or British Nautical Almanac Offices. Before the war a division of work was effected between the five principal almanac offices of the world in order to avoid duplication of large computational programs. This division and collaboration has remained in effect throughout the war. The exchange was accomplished through the intermediary of Professor Lindblad of Stockholm, Sweden.

The Rechen-Institut corresponds to the U. S. or British Nautical minor) functions and publications. The major publications are:

POPULAR ASTRONOMY

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The principal articles of this magazine, beginning with Volume **15** (1907), are listed in the INTERNATIONAL INDEX TO PERIODICALS.

1. Berliner Jahrbuch
2. Kleine Planeten
3. Astronomischer Jahresbericht
4. Astronomische Nachrichten

In August, 1944, the Rechen-Institut was evacuated from Berlin to Sermuth near Grimma in Saxony, a town divided in two by the Mulda River. When the Mulda River became the provisional frontier between the Russian and U. S. zones of conquest, the institute was on the U. S. side and part of the staff on the Russian side. Subsequently the institute and some of its staff moved to Heidelberg, where the director, Professor Kopff, had worked for nearly twenty years. With him are the following staff members: K. Heinemann, F. Gondolatsch, E. Rabe, Miss H. Nowacki, and K. Henne.

At present, at Heidelberg only the bare essentials exist for continued work: certain manuscripts, tables, computing machines, and a few books, while the financial difficulties are grave. Not taken from Sermuth were the greater part of the library and the stock of publications by the institute held there.

The library is distributed in four localities; the original institute at Berlin-Dahlem; the Potsdam Observatory; the Sermuth, Saxony, evacuation buildings; and a castle near Heilbronn (in the U. S. zone). The last named place contains the old series of the *Astronomische Nachrichten* (since 1820) and of the *Berliner Jahrbuch* (since 1754).

The stock of the institute's publications is also scattered in four places: Berlin-Dahlem, Sermuth, Potsdam, and the printer at Halle an der Saale (Druckerei des Waisenhauses), all in the Russian zone now.

The U. S. has received the Star Positions for the *Berliner Jahrbuch* for 1945, 1946, and 1947; the 1948 and 1949 positions have been computed and exist in manscript form.

The complete *Jahrbuch* for 1945 has been distributed on a small scale (Germany, Switzerland, Sweden); 1946 has been printed and lies ready at Halle, at the printer's address given above. 1947 has been partly printed (star positions), the part sent to the U. S. and Britain. But two parts of the data have not yet been received from the U. S., "Eclipses" and "Astronomical Phenomena." The manuscript, except for the two missing parts, is at Heidelberg. 1948 has been printed in small part, and is at Halle. Another part is there in manuscript form, while a third part is in manuscript form at Heidelberg. But it is incomplete. The 1949 "Positions" are in manuscript form at Halle.

The *Kleine Planeten* for 1944 have been distributed; 1945 is at Halle, printed; 1946 is mostly ready in manuscript; the completed part is at Heidelberg. Some small parts are not available, because the collaborating computers are scattered and out of reach. 1947 has not yet been started.

The "Literature for 1941" in *Astronomischer Jahresbericht,* Vol. 43

appeared in 1944. Some of the copies have been distributed and some are still in Berlin at the printers, Walter de Gruyter.

The "Literature for 1942" exists in manuscript form at Heidelberg, nearly finished. The author, Dr. Heinemann, is at Heidelberg. The "Literature for 1943" has not yet been started, since there is not enough non-German literature available at Heidelberg to make such work now possible.

The latest issues of the *Astronomische Nachrichten* are at the printers, in Halle.

The future of the Rechen-Institut at Heidelberg is complicated by the fact that it has to be supported by the tiny state of North-Baden (the U. S. part of Baden, being the northernmost quarter of the former state of Baden); this small state contains also the Heidelberg Observatory which is also state supported. A merger of the two institutions would seem indicated.

It would appear that the simplest function which the Rechen-Institut could resume is the continuation of the *Astronomischer Jahresbericht.* It would be a loss to astronomy if this useful series were permanently interrupted. Next in order might be the *Jahrbuch;* while the resumption of the other activities might be more remote, although Miss Nowacki, who did most of the editorial work on the *A. N.*, is at Heidelberg.

Professor G. Stracke, one of the key figures at the Rechen-Institut and editor of *Kleine Planeten,* died in August, 1943. An obituary, containing a review of his work and a complete list of his publications, was published by A. Kahrstedt.[1] In addition to Stracke's great merits in organizing the service that kept track of the asteroids, his recent work on Eros deserves to be mentioned. Unfortunately the wider program, which included the revision of some of the principal astronomical constants, was unfinished at his death. E. Rabe, now at Heidelberg, has taken over this program.

III Observatories

Heidelberg. The institute is undamaged and its staff has mostly returned. In particular, the valuable plate collection, obtained with the Bruce telescope, is intact and under K. Reinmuth's supervision. It is to be hoped that the positional work on minor planets, a subject cared for by very few observatories at present, will be resumed before long. During the war the director, H. Vogt, published a useful book "Aufbau und Entwicklung der Sterne" (Leipzig, 1943), and finished writing another book on extragalactic nebulae.

Munich. The Munich Observatory suffered severe damage. Ten bombs and a fighter aircraft dropped in the observatory yard. The house of the director (W. Rabe) and that of the assistant (P. Labitzke) were both partly demolished. The 11-inch refractor is intact, although the dome has sustained some damage and cannot be turned. The Repsold meridian circle was thrown out of its mounting onto the floor and one of the circles (the one without the divisions) was bent. Rabe published 5700 double-star measures in 1939[2] and has since obtained several thousand more. He has obtained 14,600 measures since 1934; over 9,400 measures of 670 systems are still unpublished, some of them going back to 1929. The library building has been destroyed but 80 per cent of the books were saved. P. Labitzke, formerly of Königsberg, is now on the observatory staff.

Bonn. The Bonn Observatory was damaged but the library was saved. Kohlschütter had left Bonn for Thüringen (Eichsfeld) in front of the Allied invasion, with his computers and the files of the new *A. G.* catalog. They have later returned to Bonn, but O. Wachtl died in action with the Luftwaffe, March, 1942.

Göttingen. The director, O. Heckmann, left Göttingen for Bergedorf early in 1941 and was succeeded by P. ten Bruggencate. During the years 1941 to 1943 K. O. Kiepenheuer's Fraunhofer Institute was located there and the construction of a modern solar institute was begun on the Hainberg, a hill just outside the town. The Fraunhofer Institute was moved away to Freiburg in the Black Forest during the fall of 1943, but the solar institute was retained for Göttingen and completed by the end of 1944. The damage done to the institute, as well as to the older observatory in the city, is negligible. In addition to the director, W. Strohmeier, formerly of Potsdam and the Afrika Korps, works at Göttingen and also, as guest, E. Schoenberg, formerly director of the Breslau Observatory. W. Becker, formerly of Babelsberg and Vienna, stayed in Göttingen temporarily but left for Bergedorf in September, 1945.

Potsdam and Babelsberg. Both the observatories are just outside the city limits of greater Berlin and are therefore in the Russian zone of Germany. Kienle, von Klüber, Hassenstein, Münch, and H. Müller remained at Potsdam. The Einstein tower is being used by Kienle, although it has been damaged. At Babelsberg Guthnick and Brill remained behind while several astronomers went west, mostly to the Hamburg area. The damage to both observatories has been unimportant but it is reasonable to expect that some of the equipment will be used by the Russians for reparations. It should not be forgotten that the Pulkova Observatory was utterly destroyed and the Simeis Observatory dismantled by the retreating Wehrmacht in 1943 and shipped to Potsdam (without Kienle's approval), where it arrived in very poor condition.

No word has been received from H. Schneller, who was last reported visiting C. Hoffmeister at Sonneberg in Thüringen. The astrophysicist, W. Grotrian, was last reported[3] at Köthen, where he was commanding a battalion that saw heavy action against the Russian army near the Elbe River, south of Magdeburg. R. Müller now lives near Hamburg; E. von der Pahlen has gone to Switzerland, L. Biermann is at Bergedorf and may join the staff there; while Miss M. Güssow is now at

Heidelberg. K. Walter had in the fall of 1941 placed himself in charge of the Polish observatories and in 1944 had been the chief of a computational bureau in Poland under Alfred Rosenberg's "Ost" (East) organization; in this bureau labor from concentration camps was used. Walter is now in western Germany.

Breslau. The observatory was intact when its director, E. Schoenberg, left the city on January 23, 1945. The stock of undistributed publications was left behind. The result of subsequent operations was unkown to him.

Leipzig. The observatory in the city was largely destroyed in December, 1943, and a new station outside the town was built. To this station the director, J. Hopmann, moved the Repsold meridian circle which he had taken from the principal Belgian observatory, at Uccle.[4] Hopmann is now in western Germany and may reportedly join the Bonn Observatory staff.

Hamburg-Bergedorf. This is perhaps the principal observatory of Germany today. O. Heckmann, a man of great ability, is the director; the other staff members are Larink, Wachmann, Wurm, Cox, W. Becker, Biermann, Vick, Dieckvoss (PW in U. S.), Fricke, Thiessen, and Reis.

In the neighborhood of Hamburg live Unsöld (at Kiel); Przybyllock, formerly director of the Königsberg Observatory (now living at Lübeck), and Dick (Büsum). Other astronomers in western Germany are P. Wellmann (Betzdorf on the Sieg) and W. Strobel (Stade on the Elbe).

Two enterprises of the Hamburg Observatory are of especial interest abroad; the Bergedorf Spectral Durchmusterung, and the repetition of the *A. G.* catalogue. The situation in September, 1945, was as follows:

A. *Spektral Durchmusterung.* Volume 3 (+30° zone): the manuscript was ready in 1943 and was sent to Stuttgart for printing. The paper for this edition was burned; it was replaced but its final fate is unknown. Volume 4 (+15° zone): the manuscript is ready with two exceptions, (1) a check on the coordinates which was to be made by the Kapteyn Laboratory at Groningen; (2) the Groningen magnitudes for the standard stars, based on Harvard plates, had not been received. Volume 5 (0° zone): the same condition as Volume 4 except for seven fields for which no Groningen magnitudes have been received (*i.e.,* for no stars at all). These fields are SA 96, 98, 99, 100, 108, 110, and 114. The only magnitudes available are rough values determined at Bergedorf from the spectral plates. (Professor Bok writes that some of the standard plates taken at Harvard had not yet been sent to Groningen while others had not yet been taken. The program at Harvard had been interrupted by the war.)

B. *The* A. G. *Repetition.* Originally the German program called for a division of the work between Bergedorf, Bonn, and Berlin (Rechen-

Institut), with the first two observatories making the observations and Berlin the reductions. Early during the war it was decided that Berlin would finish the reductions of the comparison stars only, which they did[5] while Bergedorf and Bonn would reduce and publish their own observations. In addition Courvoisier was to publish separately his catalog of red stars, double stars, and other objects not suitable for photographic observation. This catalog was also published.[6]

The Bergedorf zone extends from the north pole to +20°, the Bonn zone from +20° to —5°. The observations have all been made and the first part, +50° to +60°, is being typed for reproduction. The next zone will be +60° to +70°; thereafter +80° to +90°. These three zones have been completely reduced. The remaining zones in the +20° to +90° belt are "in revision."

The finished catalogue will give the following columns: 1. Star number, a newly assigned number, not the original *A. G.* number; 2. Photographic magnitude, newly determined; 3. R. A. for 1950, given to 0.01 sec.; 4 and 5. The precession and secular variation in R. A.; 6. Declination for 1950, given to 0".1; 7 and 8. Precession and secular variation in declination; 9. Epoch; 10. *B. D.* number.

It will be disappointing to some astronomers that proper motions have not been derived. This shows an interesting and perhaps typical difference from the views governing the large program at Yale. The U. S. astronomers decided that proper motions based on two epochs would be better than no proper motions; while the Germans discarded this policy since it would not have used 100 per cent of the existing observations. They hoped to return to the proper motions separately.

C. An interesting investigation on the *general magnetic field of the sun* is being carried out by G. Thiessen. The method is different from that used at Mount Wilson in that a rotating $\lambda/2$ plate is being used and a Fabry-Perot interferometer that produces a system of dark rings on a bright background which is then observed visually. The dark rings are caused by high orders of the Fraunhofer line used in the investigation (Fe 5250 and 6173 A). The rotating $\lambda/2$ plate causes the rings to pulsate, owing to minute changes of wave length, and the amplitude of the pulsation is a measure of the general magnetic field. provisional determination of the field strength is 53 ± 12 gauss.

Of interest also is an investigation by K. Wurm on the determination of the magnetic field observed from the spiral motions in comet tails. A field strength of 10^{-6} gauss is found at one astronomical unit from the sun, consistent with the strength of the general magnetic field found on the solar surface.

Finally it may be recorded that Heckmann's high-precision work on the color-magnitude diagrams of galactic clusters was continued. In addition to the earlier work on the Praesepe and the Pleiades, now the Hyades have been added. The Hyades diagram is very similar to that of Praesepe.

The equipment at Bergedorf is undamaged although some 200 incendiaries fell on the grounds. At the close of the war the 1-meter mirror (f/3) happened to be at Zeiss, Jena, for realuminizing and has not yet been recovered. The rest of the instrument is at Bergedorf.

Mussolini's Observatory. The Führer had announced with much fanfare that he was going to present the largest observatory in Europe to his friend, the Duce. Zeiss was going to produce it. Actually what happened is this:

The domes were complete in 1941 and were sent to Italy during the winter 1941-42. Professor Abetti of Florence was to be in charge of the institution. The domes were partially mounted in 1942. But BHF[7] (at that time Plendl) got them back to Jena, Germany, about December, 1943. The instruments themselves were never sent to Italy. They were ready early in 1944, except for the 1.5-meter Schmidt mirror. The mounting for this instrument had been started. The following instruments were ready:

1. Universal passage instrument.
2. Visual refractor, 60 cm aperture, 1100 cm focal length. (A few finishing touches were still to be made.)
3. Blink comparator.
4. Zeiss photoelectric photometer.
5. An astrograph.
6. Auxiliary equipment.

The plans had been made by Professor Bianchi, an Italian astronomer, who used conservative designs. The absence of modern solar equipment was regretted by some of his colleagues.

The Fraunhofer Institute got the dome for No. 2, and also items Nos. 3 and 4. All other instruments and domes remained in Jena.

The German Reich had paid Zeiss for the domes already shipped to Italy but not for the items still at Jena. BHF wanted to pay for the large refractor, but the arrival of the Americans intervened. The refractor was to be for the Fraunhofer Institute (Schauinsland).

The Potsdam Observatory was to get the astrograph (No. 5), and the Hamburg Observatory the 1.5-meter Schmidt mirror. But the Fraunhofer Institute got the best part—the part that was ready.

It has since been reported that the Schmidt telescope is being finished at Jena for the reconstructed Pulkova Observatory.

IVa The Fraunhofer Institute

German solar research was coordinated by K. O. Kiepenheuer, director of the Fraunhofer Institute. It was part of a larger organization, the Reichsstelle für Hochfrequenzforschung e.V., whose chief was first Plendl and, after the fall of 1943, Esau. This shows that German solar work was carried out for the purpose of forecasting ionospheric conditions. Kiepenheuer's claims in this connection were not fulfilled during the war (although it is possible that continued research would have justified them). But astronomy has greatly gained by the erection of six solar observatories, four of which have survived the war. It is doubtful whether in time of peace such an ambitious program could have been carried out. Incidentally, this considerable expenditure was made at the cost of the German war effort.

It was Kiepenheuer's program to coordinate and foster solar research, not only in Germany and Austria, but also in occupied countries. The solar institutions of occupied lands were given protection from interference by the German military in exchange for collaboration. It is not surprising that such efforts were suspected in spite of the tact which Kiepenheuer employed. For instance, Kiepenheuer's attempts to bring the Belgrade observatory within his organization were largely frustrated by the removal of coelostat mountings by the Yugoslav underground. The spectroheliograph[8] was thereupon requisitioned and used, together with German equipment, to build a solar observatory near Syracuse, Sicily.

As a result the principal stations contributing solar data to the Fraunhofer Institute were the station in Sicily, four new Alpine observatories, described below, and the Potsdam Observatory. The solar station at Göttingen was also built under this program but was not completed until late 1944 (see page 266). Research work at Göttingen did not start until September, 1945, when the university was reopened by the British Military Government.

Syracuse, Sicily. Solar observations started in the spring of 1942. The first instrument was a Steinheil refractor $f = 100$ cm, with which images 8 cm in diameter were taken in white light. The relative sunspot numbers, R, were determined as well as the spot coordinates, and the results were relayed by radio to the "Zentralstelle für Funkberatung," a sister institution under the directorship of Dr. Dieminger, dealing specifically with ionosphere research and radio forecasting. During the summer of 1942 the Belgrade spectroheliograph with Zeiss coelostats was added, and complete work was begun in the winter 1942-43. Spectroheliograms were taken in Hα and Ca II (K3 line); the images were 4 cm in diameter.

With the Allied conquest of Sicily, late in 1943, the equipment failed to get evacuated to Germany, because the director of the station, P. Wellmann, was absent during that time. The equipment was left at Catania airport in boxes marked "E-Stelle Rechlin" (the address) and "Askania Werke" (the manufacturer), but no name was added. The spectrograph contained a plane Rowland grating.

The Alpine Observatories. These observatories were constructed primarily for the observation of the corona, with a Lyot-type coronagraph. Dr. Lyot himself had forstalled weak German attempts of using the Pic du Midi Observatory in the Pyrenees. Four stations were built, one in the Black Forest above Freiburg, two in the Bavarian Alps, and one in the Austrian Alps. Their equipment and staff at the close of the war were as follows:

1. *Schauinsland*, above Freiburg i. Br., 1295 meters high. Equipment:

(a) A tower telescope, with grating-type spectroheliograph; main objective 20 cm aperture, 5 meter focal length; grating by Zeiss, Jena. (b) A second tower telescope, for continuous observation of magnetic-field strengths in sunspots, using an interferometer. (c) A twin refractor for general survey of the solar disc and photography of prominences through an interference filter; dimensions: apertures 15 and 11 cm, focal lengths 2.25 and 1.65 meters. (d) A photoelectric photometer and other auxiliary equipment. (e) An unfinished coronagraph of new design (a rotating objective with synchronous scanning device).

Staff: Dr. Kiepenheuer, astronomer and director, Pfalzgraf (photographer and chemist), Deichmann (mechanic), Bünemann and Giesekus (physics students).

2. *Wendelstein*, near Brannenburg on the Inn, south of Rosenheim, Bavaria, 1840 meters high. Equipment:

(a) A tower telescope with spectroheliograph containing a Rowland grating (from the second Physics Institute, Göttingen). The main objective is 20 cm aperture, 5 meters focal length. (b) A coronagraph, 11 cm aperture, 1.65 meters focal length, with a refractor, having the same dimensions, mounted parallel. The coronagraph has an interference filter, a prominence spectrograph and a scattered-light photometer. (c) A photoelectric photometer. (d) A blink comparator, and other small articles.

Staff: Dr. Haffner, astronomer; a physics student (Mr. Jäger) and his wife, who is a technical assistant.

3. *Zugspitze*, near Garmisch-Partenkirchen, 3000 meters high. Equipment:

A coronagraph, 11 cm aperture, 1.65 meters focal length, with a refractor of the same dimensions mounted parallel.

Staff: Dr. Bruzek, astronomer.

4. *Kanzelhöhe*, near Villach, west of Klagenfurt, Austria, 1500 meters high. Equipment:

(a) A tower telescope with spectroheliograph, Rowland concave grating, R = 3 meters. Primary objective 15 cm aperture, 4 meters focus. (b) A coronagraph with parallel refractor, as on Wendelstein and Zugspitze. (c) A photoelectric photometer.

In preparation was a coronagraph, 20 cm aperture, 3 meters focus, to be put farther northeast on the Kanzel, 1900 meters high. The dome was delivered by Zeiss and the rest is nearly ready, at Zeiss, Jena.

Staff: Ing. Marius, a physicist, and Miss Gerda Conrad, technical assistant.

The Zugspitze station was found damaged by soldiers, although the coronagraph objective may have been rescued when the astronomer left the station. The other three observatories are completely intact.

Kiepenheuer moved the Fraunhofer Institute from Göttingen to Freiburg in the fall of 1943. At first he had quarters in the mathematical institute of Freiburg University but later acquired one floor of the small castle at Ebnet, three miles east of Freiburg and some ten miles from the mountain station. The university suffered heavy damage during an aerial attack in November, 1944, but the library and equipment of the institute were largely saved.

Ebnet and Schauinsland are in the French zone of Germany and the astronomical work is continuing on a limited scale. The food problem is quite serious, as in other parts of Europe. The observing conditions at the mountain station are favorable, though surpassed by those at Wendelstein. The latter observatory has one of the finest locations in the world. The view of the chain of towering Alps, from Zugspitze, 100 km to the west over the high Tyrolean Alps to the Hohe Tauern, 100 km to the southeast, is unexcelled. The observatory is above the tree line and the sky is usually free from dust and fibers from vegetation.

The Kanzel Observatory is built on a mountain chain bordering the Drau valley from the north, running from Klagenfurt to Villach. On the opposite or southern side of the valley one sees a wild mountain range in which Yugoslav partisans held out all during the war, with Allied aircraft dropping supplies by parachute. The climate is much milder than that at Wendelstein, but the air contains quantities of fibers from the dry moss which covers the trees. As a result the site is not suitable for coronal observations except during a few days each year. The university of Graz has taken over the observatory and Professor Fell, of Graz, is now in charge.[9] Professor Fell and Miss Conrad have indicated their desire to continue the solar observations, and to try to locate a better site for the coronagraph, elsewhere in the Austrian Alps.

IVB Scientific Results

The Fraunhofer Institute issued a number of publications, which are abstracted below. The abstracts are translations of the original German summaries. In addition a colloquium was held on the Wendelstein (January 10-13, 1944) in which a number of papers were presented bearing on solar research and solar-terrestrial relationships. The titles of these papers are also listed below.

Report (Forschungsbericht) No. 1. Relations Between Solar Eruptions and Geomagnetic Disturbances. By H. Giesekus and K. O. Kiepenheuer, November 15, 1943.

A statistical discussion of observations extending over seven years (1935-41) shows it to be very improbable that chromospheric eruptions are the cause of geomagnetic disturbances or of magnetic storms. A weak correlation seems to exist but this shows only that both phenomena have a common cause, an "active area" on the sun.

FB No. 2. A Comparison Between the Limiting Frequencies at Syracuse with Geomagnetic and Solar Phenomena. By P. Wellmann, Deccember 21, 1943.

There are three components to the mean daily limiting frequencies of the F2 reflection, observed at Syracuse between September 1, 1942, and May 31, 1943: 1) a basic curve with the seasonal variation; 2) sudden minima lasting a few days, caused by corpuscles; 3) slow variations, lasting some weeks, correlated with the strength and frequency of disturbance centers on the sun. The *second* class has the following properties: they start one day after the beginning of the magnetic storm, their maximum comes ¾ day later; they fall off more slowly than the magnetic disturbance and last about two days longer. The *third* class is studied by introduction of a number indicating the *faculae activity* on the disc. At the maximum of this activity (during the interval of the observations) the limiting frequency rose about 1 MHz (1 megacycle). It is probable that the UV activity of the hot faculae are the controlling factor.

The limiting frequencies obtained at Rechlin confirm the Syracuse results but they are less useful because of the frequent occurrence of short-period (corpuscular) disturbances.

Colloquium on Solar Physics, Wendelstein, January 10-13, 1944. Program:

Kiepenheuer: Problems of the Solar-physics Group.

Haffner: Corona observations on the Wendelstein and the Zugspitze, 1943. (FB No. 3)

Kiepenheuer: Deviations from thermal equilibrium in the outer layers of the sun. (FB No. 4)

Kienle: The continuous spectrum of the sun between 3000-4500 A.

Wellmann: A comparison between . . . etc. (FB No. 2)

Bartels: Proof of the 27-day repetition in geomagnetic disturbances through 14 solar rotations.

Heckmann: Results with a spectroheliograph.

Dieminger: A meridian cross section through the ionosphere.

Biermann: The theory of the magnetic fields on the sun.

Wurm: Magnetic field in tails of comets.

Dieminger: Galactic noise (between 2-20 meters).

Wille: Photoelectric photometry of the night sky.

Ehmert: Cosmic rays and solar magnetic field.

FB No. 3. Results from observations of the corona on the Wendelstein and the Zugspitze. By H. Haffner, February 20, 1944.

Two identical coronagraphs of the Lyot type ($A = 11$ cm; $F = 165$ cm) were mounted on the Wendelstein and the Zugspitze during the spring of 1943. This article discusses the observations made from May to November, 1943, in the green coronal line λ 5303, and particularly the spatial distribution of the monochromatic corona and its relation to geomagnetic variations.

A pronounced zonal distribution of the coronal material is found between latitudes ±65°. There is a difference between the zones with and zones without sun-spots (intensity, extension). The brightest parts of the corona are usually connected with large groups of spots of long duration, but exceptions do occur in which bright coronal rays are found without special photospheric features. If the coronal intensities are derived for all solar meridians (from observations of the limbs) and then each time collected into a 60° zone around the center of the apparent disc, these zone intensities show a parallelism with the variations of terrestrial magnetism (as found at Potsdam). Nineteen maxima of the magnetic field are present which in 15 cases coincide with coronal maxima; while of the 17 coronal maxima, 15 coincide with magnetic maxima. No quantitative interpretation is as yet possible.

FB No. 4. Deviations from thermal equilibrium in the outer layers of the sun. (Theory of faculae and the corona.) By K. O. Kiepenheuer, February 25, 1944.

The electrical conductivity of the solar atmosphere is computed depending on optical thickness, density, degree of ionization and magnetic field strength. Based on the computed conductivity the magnetic field near a sun-spot is computed, as well as its variation with time. Taking into account chromospheric turbulence one finds that the Joule heat developed by the induction currents is not negligible as a source of energy, and that it provides an explanation of the deviations from thermal equilibrium observed in faculae. The kinetic energies of the charged particles in the induction current may exceed appreciably the value kT⊙. One may expect local temperatures up to 10,000° or more, which however in the visual spectrum cause only slight increases in brightness.

The energy balance of the corona is discussed. The corona consists essentially of protons and electrons only. Free-free transitions produce about 10^5 erg/cm²sec., with a spectral distribution which for $\lambda < 1000$ A exceeds the photospheric intensity by several powers of 10. This high UV intensity may well be regarded as the source for the ionization of the F2 layer.

It is assumed that the corona is not supported by radiation pressure, but corresponds to a Boltzmann atmosphere with $T \sim 10^6$. Maintaining this temperature requires an emission of about 10^5 erg/cm²sec. This cannot take place in the UV nor as fast corpuscles because the chromosphere would show the signs of it.

The general magnetic field of the sun is quantitatively insufficient as an energy source. More promising is a stream of slow particles passing through the chromosphere and accelerated inside the corona. The lifetime of an H atom and the radiation pressure on it are estimated. It is found that small deviations from thermal equilibrium in the chromosphere suffice to cause accelerations of the H atoms by the required amount. *The energy source of the corona is therefore assumed to be the Lyman series emitted by the chromosphere* (taken over the *whole* solar surface).

It is pointed out that the absolute intensities of the coronal lines agree with the assumption that the coronal ions (Fe, Ca, Ni) are of meteoric origin. The concluding remarks concern solar-terrestrial relationships.

Properties of the ultra-violet radiation of the sun. By K. O. Kiepenheuer, February, 1944. (A short paper superceded by FB No. 5.)

FB No. 5. The Absolute Intensity and Other Properties of the Solar UV Radiation (λ 600-900 A) that Produces the Ionosphere. By K. O. Kiepenheuer, August 1, 1944.

An investigation is made of the production of charged particles in the ionosphere, as well as of their recombination. The purpose is to determine the absolute intensity of the UV radiation in the sun, and its variation.

The resulting estimates show an excess over black-body radiation ($T_\odot = 5780°$) by a factor roughly 10^5 for the E layer (λ 661-744 A) and the F_1 layer ($\lambda < 661$ A); and an excess roughly 10^3 for the F_2 layer (λ 744-910 A). The analysis of the daily F_1 and F_2 limit frequencies obtained in 1941-43 gives a *linear* relationship between sun-spot number, R, and intensity of the ionizing radiation. More precisely, *during a sun-spot cycle (between $R = 0$ and $R = 150$) the strength of the E layer changes in the ratio 1:2.4 of the F_1 in the ratio 1:2.6, and the F_2 as 1:12.* The variation of the F_1 layer, and probably also of the F_2 layer, has two components: a) a slowly changing component which follows the sun-spot numbers R with a delay of a few solar rotations; presumably it depends on the whole solar disc; and b) a rapidly changing component, following the numbers R without phase shift; presumably it is due to limited disturbed areas on the sun.

The sun is therefore strongly variable in the UV. Because of the strong absorption such UV radiation would experience in the solar atmosphere, the source of it must be in the outer parts of the chromosphere or the inner parts of the corona.

It is shown that component a) of the F_1 layer may be interpreted as due to the free-free and free-bound transitions in the inner corona, the latter being mainly composed of free electrons and protons with $T > 10^5$ degrees. Not only the absolute strength but also the correlation with sun-spot activity point to this conclusion.

An estimate is made of the strength of the Lyman continuum radiated by prominences and faculae. It is found that the granules of the faculae are strong UV sources; they are assumed to be responsible for the rapidly varying components b) of the F_2 and F_1 layers. This conclusion is consistent with the absolute strength of components b) and their close correlation with R.

The remaining intensities of the E, F_1, and F_2 layers during the sun-spot minimum ($R = 0$) are assumed to be due to the many small prominences which form the top of the outer chromosphere; the frequency of these seems to be independent of the sun-spot cycle.

Mitteilungen des Fraunhofer-Institutes.

No. 1. Minimum of the Relative Sunspot Number, by E. Walker, September 28, 1944.
No. 2. The Evolution of Sunspots, by E. Walker, October 3, 1944.
No. 3. The Visibility of Sunspots and Sunspot Goups, by A. Bruzek, November 1, 1944.

From these abstracts it is clear that the scientific work carried out was on a high level. Particularly papers No. 4 and No. 5 are of great interest to astrophysicists. It is hoped that soon more extensive account of this work can be given. Most of the papers presented during the Wendelstein conference (see above) have been printed in abstract form only. These abstracts, as all other papers issued by the Fraunhofer Institute, are on file at the Yerkes Observatory.

The great store of coronal observations collected by the Fraunhofer Institute, especially at the Wendelstein, will be of great value in further studies of solar-terrestrial relationships. Dr. Kiepenheuer is making available microfilm copies of his records. It is to be hoped that these difficult observations which had run for years continuously will be permitted to be resumed, particularly since Dr. Lyot's observations on the Pic du Midi are not yet continuous.

Attention is further drawn to some remarkable unfinished projects. Kiepenheuer, in collaboration with Regener, made a strenuous effort to measure directly the far ultra-violet intensity of the sun. It was proposed that recording equipment be shot up to very high altitude and the following three quantities be measured: a) the intensity of the Lα in the sun; b) the intensity of the continuous spectrum on each side of 1000 A; c) the intensity of cosmic rays at the top of the atmosphere.

The first method adopted for reaching very high altitudes was by use of the V2 rocket. The first experiments called for attaining the altitude of 60 km; the figure was later to be increased to 140 km. The German services had promised these men a V2 in which the warhead would be replaced by a cylinder one meter high and 80 cm in diameter, in which they could put any measuring equipment they chose.

A LiF (UV) spectrograph was constructed with a novel type of recorder. Because of the possible weakness of the solar far UV compared to the intensity in the normal photographic region (for a black body of 6000° the ratio at λ 800 A would be about 10^6), the problem of scattered light in the spectrograph might be extremely severe if photographic plates were used. For this reason the photographic plate was replaced by a set of halegonid crystals as devised by the physicist Pohl and his co-workers at Göttingen. Such crystals discolor when exposed to UV radiations of a narrow specified wave-length band and the change of color is a measure of the total radiation received in that band. Kiepenheuer used this device by putting crystals of the proper wave-length sensitivity along the focal curve of the spectrograph. In this ingenious way the problem of scattered light was completely solved. The sensitivity of the device was increased by a special procedure enabling the measurement of intensities too weak to give noticeable color effects. Exposed crystals were afterwards irradiated with red light and the change of internal resistance was measured. This procedure measured the number of free Na ions in the crystal caused by the original UV rays.

It was the plan to have the cylinder with the spectrograph and the cosmic-ray equipment ejected from the V2 at maximum altitude. During the ejection, the cylinder would receive a slight spin so that it would have a corkscrew motion going down; it would be parachute supported. The spectrograph was so constructed as to admit light from a 90° vertical arc (from the zenith to the horizon if properly oriented) but with a narrow beam at right angles. With the cylinder rotating the sun would enter the spectrograph a definite fraction of the time regardless of the speed of rotation.

The cylinder, with its equipment, was ready in July, 1944, but by then Regener and Kiepenheuer did not succeed in getting their V2. Their next attempt was to insert Pohl-type crystals without a spectrograph, simply as recorders of UV radiation, first in 21 cm shells used in railroad guns of very high muzzle velocity (about 1400 m. sec^{-1}) and later in small rockets. In this manner it was hoped that at least medium altitudes of 60 to 80 km could be reached. The final and simplest device was a rocket which, together with its launching tube, weighed only 5 kg and would be carried by means of a cluster of balloons to somewhat over 30 km elevation before being fired. Because of the rapidly changing conditions in Germany during 1944 and 1945 no final results were achieved before the end of the war. The only complete test was one obtained in the very beginning of the program, in 1939, when a cluster of six pilot balloons carried a series of Pohl crystals to 31 km elevation and recorded radiation in the gap near 2000 A, between the oxygen and ozone absorption. No calibrating device was then available, however, so that no numerical data can be given.*

V General

1. This report would be unbalanced without a reference to the darker side of the picture. In the first place there is the aggressive Nazi activity on the part of some astronomers. The majority of the astronomers are not in this class. In fact, among many there was a latent feeling of dissatisfaction with Nazi theories, though only a few scientists expressed such views openly. Among these are von Laue in physics, and Heckmann in astronomy. Nearly all astronomers who were not party members before the war became members during the war. I

*A few additional data are found in *V.J.*, **75**, 103, 1940.

know of only one notable exception. This will be disappointing to many of us in view of the violent anti-intellectual stand the Nazi party had taken up to about 1941; when, *e.g.*, theoretical physicists were often classed with "Jews and Marxists."

Many of the younger astronomers participated actively in one of the German services, but in 1943 most of them were released as part of the general program to bolster science. This step was taken, as a result of the initiative of Esau and particularly Osenberg, after the comparative weakness of Germany's scientific preparation had been demonstrated. The surprising thing is that the recalled astronomers, as their older colleagues, and their colleagues in some other fields, did mostly work of their own choosing, often with government support.

2. The attitude of some astronomers is demonstrated by their own publications. *E.g.*, the German director of the Graz Observatory, K. Stumpff (formerly of Breslau) writes in his report for 1942:[10]

"The nucleus of the new observatory at Graz will be made up out of several fairly large instruments of the Belgrade Observatory which, according to the Dictate of Versailles, the Reich had to deliver to the former Yugoslav State, and which now had to be returned." He continues in his next year report:[11] "The Belgrade instruments assigned to the Graz Observatory could not yet be moved in 1943. As a result of two trips I made to Belgrade I got assurances that they will be shipped by the summer of 1944." (See, however, footnote 8.)

Other removals of astronomical equipment from Allied territory are the two important telescopes from Uccle, Belgium (see p. 267) and the dismanteling of the Simeis Observatory (see p. 266). Uccle and Belgrade have one point in common: both had obtained reparation equipment after the first world war.

3. One of the symptoms of intellectual deterioration in Nazi Germany was the wide-spread use of pseudo-scientific theories. Not only was astrology widely practiced, even in Hitler's headquarters, but the theory of the world ice was popular, as well as the theory that the world was a hollow shell, with the human race living on the inside (Hohlwelttheorie). The following illustrations may suffice:

a. Dr. W. Führer, a graduate of Kiel (Rosenberg, Unsöld) and later an associate of the physicist Lenard at Munich, was "Referent für Mathematik, Astronomie und Physik" under Ministerialdirektor Mentzel, 1940-1943. In this important capacity he had a large share in making Nazi appointments to German universities. (*e.g., the successor to Sommerfeld!*). In 1943 he reportedly became official astrologer for Himmler and Hitler, at the Führer's headquarters.

b. Certain German naval circles believed in the Hohlwelttheorie. They considered it helpful to locate the British fleet, because the curvature of the Earth would not obstruct observation.

Visual rays were not suitable because of refraction; but infrared rays had less refraction. Accordingly a party of about ten men under the scientific leadership of Dr. Heinz Fischer, an infrared expert, was sent out from Berlin to the isle of Rügen to photograph the British fleet with infrared equipment at an upward angle of some 45°.

c. Other groups, including officers of flag rank, practiced or supported "Pendelforschung": a large map of the Atlantic was spread out horizontally, with a 1-inch toy battleship as test object. A pendulum, consisting of a cube of metal (about 1 cm^3) and a short string, was swung above the battleship. If the pendulum reacted it proved the presence of a true battleship at that location.

d. This intellectual regression is only part of the general anti-cultural movement that supported Nazism. Other symptoms are (a) the racial theories, (b) the sacrifice of conscience to the will of the race (as personified in the Führer), which often resulted in extreme cruelty.

e. Most scientists did not actively support the anti-intellectualism of the Nazis, and combatted the pseudo-scientific theories (though not always the racial theory). In this connection a book by R. Henseling, "Umstrittenes Weltbild," Leipzig, 1939, may be quoted. In fairness it should be stated that the milder forms of pseudo-science are not confined to Germany.

VI German Astronomical Publications during the War

The lists of publications given below should be essentially complete for the following observatories: Heidelberg, Göttingen, Munich, Hamburg-Bergedorf, the Rechen-Institut, and the Fraunhofer Institute. Information received on publications by other observatories was less direct, and only the principal issues have been listed. Complete information up to the end of 1943 may be obtained from the year reports of observatories, listed below.

Articles in common periodicals, as *Zs. f. Ap.*, *A. N.*, *B. Z.*, are usually not listed separately since these periodicals are listed themselves. Only for observatories where a complete list was at hand have all titles been retained.

A copy was secured of all publications issued by observatories visited; they are on file at the Yerkes Observatory and are available for reference and reproduction to interested astronomers. Publications for which no copy is at hand are listed with an asterisk.

Many of the publications have already been circulated in the U. S. thanks to the Committee for the Distribution of Astronomical Literature (Chairman, Dr. B. J. Bok). The Bulletins issued by C. D. A. L. further contain useful abstracts. Titles given below for which such abstracts have been issued are followed by the C. D. A. L. Bulletin number in parentheses.

One of the tragedies of this war has been the burning of books and magazines. The great publishing centers of Leipzig, Berlin, Braunschweig, and Dresden, as well as some lesser ones, sustained heavy fire damage in air raids. Many complete editions as well as the undistributed stock of other editions have perished. The problem of completing our libraries deserves careful study; the modern litho-process is both adequate and inexpensive.

1. Books. In addition to several popular books (reviewed in *Vierteljahrsschrift*) the following more important books have been issued:

*H. Happel, Das Dreikörperproblem, Leipzig, 1941.—According to the review by Prof. A. Klose of Berlin (*V. J.*, **77**, 254, 1942) an important book which includes the newer methods and results.

*M. Waldmeier, Ergebnisse und Probleme der Sonnenforschung (Probleme der Kosm. Physik, Bd. 22), Leipzig, 1941.—Review by ten Bruggencate, *V. J.*, **77**, 262, 1942. (14).

E. Kamke, Differentialgleichungen, Lösungsmethoden und Lösungen (2 vols.) Leipzig, 1942.—A very fine book.

*E. Zinner, Geschichte und Bibliographie der astronomischen Literatur in Deutschland zur Zeit der Renaissance, Leipzig, 1941.—Review by Willy Hartner, *V. J.*, **76**, 166, 1941.

*W. Becker, Sterne und Sternsysteme, Leipzig, 1942. (14).

Otto Heckmann, Theorien der Kosmologie, Springer, 1942. (14).—A penetrating and spirited review by von Weiszäcker, *V. J.*, **78**, 208, 1943.

W. Heisenberg, Kosmische Strahlung, Springer, 1943.

H. Vogt, Aufbau und Entwicklung der Sterne, Leipzig, 1943.—A clear, compact, and useful small book.

In press at the end of the war:

*Newcomb-Engelmann, Eighth Edition (edited at the Potsdam Observatory).

*H. Vogt, Die aussergalaktische Nebel.

(*)H. G. Küssner, Principia Physica (Herausgegeben von der Deutschen Akademie der Luftfahrtforschung).—(Professor Küssner was attached to the Aerodynamische Versuchsanstalt, Göttingen).—This book was highly praised by Sommerfeld, but because it appeared to contain a great deal of cosmological speculation the writer requested Professor Pascual Jordan to review it. Jordan's opinion was quite critical. Since the book plates are in Berlin and only a final proof copy exists at Göttingen the future of this book is uncertain. An eight-page abstract, written by Küssner, was secured and is on file together with Jordan's review.

In addition, a number of important *mathematical tables* were printed. At least two of these have been re-issued in the U. S. under the auspices of the Alien Property Custodian: "Seven-place Values of Trigonometric Functions for every 0°.001" and "Eight-place Table of Trigonometric Functions for every Second of the Quadrant." Both are by Prof. J. Peters.

2. *Vierteljahrsschrift der A. G.* The following volumes have appeared: **75**, 1940; **76**, 1941; **77**, 1942; **78**, 1943; **79**, 1944. Vol. 79 consists of a single issue; the other volumes of four "Hefte," with the second and third, each time, combined into one issue.

This publication gives a great deal of information on the activities of German observatories and their personnel during the war. Some of the more important items are listed below.

a. *Year Reports* of German and Austrian observatories.

Year 1939	Vol. 75,	42-172, 1940
1940	76,	52-161, 1941
1941	77,	104-230, 1942
1942	78,	101-198, 1943
1943	79,	10- 84, 1944

Included also are the reports for Arcetri and Zurich (up to the end) and Vatican and Stockholm (up to Vol. 78).

The report of K. Walter on his Polish observatories ("Sternwarten des Generalgouvernements") deserves special mention (Vol. 79, 42-56, 1944). Dr. Wilk's death in February, 1940, is recorded, but not its cause (starvation, according to a report received). The gradual elimination of Professor Banachiewicz is only casually mentioned, but not his imprisonment after the fall of Poland, or the scientific isolation imposed on Polish scientists after 1942 by preventing them to write to scientists outside the Generalgouvernement. Neither is a description given of the "Institut für Deutsche Ostarbeit in Krakau" (*cf.* p. 267). Incidentally, Drs. Biermann and Wellmann received the Kopernikus Preis of this Institute in 1943 (*V. J.*, **79**, 14, 1944).

Reference is also made to Hellerich's reports on the Strasbourg Observatory; later he became a prisoner of the French.

b. Discoveries of *asteroids* are listed by:

A. Kahrstedt, Zusammenstellung der Planetenentdeckungen im Jahre:

Year 1939	Vol. 75, 28-39, 1940
1940	76, 40-47, 1941
1941	77, 87-98, 1942
1942	78, 88-97, 1943
1943	79, 85-92, 1944

c. *Comets* are reviewed by:

H. Müller, Zusammenstellung der Kometenerscheinungen:

Year 1938	Vol. 75, 23-27, 1940
1939	76, 23-39, 1941
1940	77, 76-86, 1942

d. A number of important *original contributions* appeared in the *V. J.*

P. ten Bruggencate, Die Häufigkeit des Wasserstoffs in Sternatmosphären; **75**, 203-252, 1940.

Symposium on Solar Physics, Göttingen, Oct. 3-4, 1941: P. ten Bruggencate, Wasserstoffhäufigkeit und Turbulenz in der Sonnenatmosphäre; **76**, 172-184 (9).

H. Siedentopf, Sonnengranulation und zellulare Konvektion; **76**, 185-193 (9).

L. Biermann, Der gegenwärtige Stand der Theorie konvektiver Sonnenmodelle; **76**, 194-200 (9).

K. O. Kiepenheuer, Die Ausstrahlung der Sonne im fernen Ultraviolet; **76**, 201-206 (9).

K. Wurm, Die Natur der Kometen; **78**, 18-87, 1943. Errata p. 260.

A. Unsöld, Über die Theorie der Druckverbreiterung und -verschiebung von Spektrallinien; **78**, 213-259, 1943.

e. Obituaries:

Anders Donner	(1854-1938)	by E. Strömgren	**75**, 2, 1940
Gustav Eberhard	(1867-1940)	by H. Ludendorff	**75**, 174, 1940
Paul V. Neugebauer	(1878-1940)	by G. Stracke	**75**, 185, 1940
Hans Ludendorff	(1873-1941)	by P. Guthnick	**77**, 2, 1942
Jean Peters	(1869-1941)	by O. Kohl	**77**, 16, 1942
Karl Boda	(1889-1942)	by W. Hartner	**77**, 232, 1942
Hermann Kobold	(1858-1942)	by M. Ebell	**77**, 241, 1942
Gustav Stracke	(1887-1943)	by A. Kahrstedt	**79**, 1, 1944

Conspicuously missing among the obituaries is that of Professor R. Emden, the great pioneer of theoretical astrophysics and founder of the *Zeitschrift für Astrophysik.* He died October 8, 1940, at Zurich, Switzerland. Other deceased astronomers:

Dr. B. Jung (Breslau), H. von Hoff (Göttingen), Prof. A. von Brunn (Potsdam), in 1940; Prof. Ph. Fauth (Grünewald), Prof. M. Maggini (Teramo), Prof. E. Bianchi (Milan), in 1941; Dr. F. Schembor (Vienna), E. J. Meyer (Wolfersdorf), Dr. O. Wachtl (Bonn), in 1942; Prof. J. Stobbe (Posen), Dr. H. Strebel (Munich), Prof. A. Galle (Potsdam), in 1943. Further Dr. Beilke (Göttingen and Potsdam) has been missing at Stalingrad (December, 1942).

(*) 3. *Zeitschrift für Astrophysik.* Microfilm copies were obtained in 1944 in Paris up to the end of Vol. 22 (end of 1943). Three issues of Vol. 23 have appeared in 1944, but no spare copies were found in western Germany. Many important articles have appeared in this magazine, among which we mention Unsöld's series on τ Scorpii; Biermann's work on convection and the composition of the sun; and von Weiszäcker's article on the origin of the solar system. Most of these articles have been listed and abstracted in *C. D. A. L. Bull.,* 2, 4, 7, 8, 9, 10, 14, 22. Some of the important ones have been reviewed in the *Astrophyical Journal.*[12]

(*) 4. *Astronomische Nachrichten.* The last volume is 274 (incomplete). For titles and abstracts see *C. D. A. L. Bull.,* 3, 4, 7, 8, 10, 14.

* *Beobachtungs Zirkulare der A. N.* continued to appear in 1944. Vol. 25 (1943) had 21 numbers, 124 pages.

* *Astronomische Abhandlungen.* The following numbers appeared: Vol. 10, Nos. 2, 3 (1940); 4-6 (1941); No. 7 and Vol. 11, No. 1 (1942); No. 2 (1943). For titles of Vol. 10, *cf. C. D. A. L. Bull.*, 14, p. 7.

5. *Rechen-Institut publications.* The fate of the principal publications, *Kleine Planeten, Berliner Astronomisches Jahrbuch,* and *Astronomisches Jahresbericht,* has been reviewed in section II. Dr. Heckmann of Bergedorf has made available a copy of each volume of *Kleine Planeten* and *Berliner Jahrbuch* that had appeared (1942, 43, 44 and 1943, 44, 45, respectively); while Dr. Kopff made available a partially complete copy of the 1946 *Jahrbuch* as well as the *Jahresbericht,* literature for 1941.

The following *Mitteilungen* have appeared, beginning with 1940: Band 5, No.

6: E. Rabe, Die Bahn des Planeten 1 Ceres, *A. N.*, **270**, 82.

7: G. Stracke, Elemente und Numerierung von Kleinen Planeten, *A. N.*, **270**, 93.

8: A. Kahrstedt, Zusammenstellung der Planetenentdeckungen im Jahre, 1939, *V. J.*, **75**, 28.

9: W. Gliese, Bestimmung der Sonnenbewegung und der galaktischen Rotation, hergeleitet aus den Eigenbewegungen des FK3, *A. N.*, **270**, 127.

10: G. Miczaika, Die Sterne grosser Geschwindigkeit, *A. N.*, **270**, 249.

11: G. Hagemann, Die Radialgeschwindigkeiten der Sterne des FK3, *A. N.*, **271**, 1.

12: E. Rabe, Über die mittleren Bewegungen im Hecuba-Problem, *A. N.*, **271**, 92.

13: E. Rabe, Periodische Lösungen für die Bewegung eines Doppelplanetoiden, *A. N.*, **271**, 181.

14: G. Stracke, Elemente und Numerierung von Kleinen Planeten, *A. N.*, **271**, 186.

15: A. Kahrstedt, Zusammenstellung der Planetenentdeckungen im Jahre 1940, *V. J.*, **76**, 40.

16: G. Stracke, Über die Abnahme der Helligkeiten der Kleinen Planeten, *A. N.*, **271**, 280 (4).

17: G. Stracke, Die Eros-Bewegung von 1940-42 und die Eros-Ephemeride für 1942, *A. N.*, **272**, 27.

18: G. Stracke, Elemente und Numerierung von Kleinen Planeten, *A. N.*, **272**, 82.

19: W. Gliese, Die Untersuchung der Raumgeschwindigkeiten der FK3, *A. N.*, **272**, 97.

20: A. Kahrstedt, Zusammenstellung der Planetenentdeckungen im Jahre 1941, *V. J.*, **77**, 87.

21: A. Kopff, Die Genauigkeit des Katalogs der Anhaltsterne des AGK2, Abh. der Preuss. Akad. d. Wiss., 1942, No. 5.

22: W. Gliese, Abschätzungen des Kraftfeldes der galaktischen Rotation, *A. N.*, **272**, 201.

23: G. Stracke, Über die geometrische Gröse und die Masse der Kleinen Planeten, *A. N.*, **273**, 24 (14).

24: E. Rabe, Genäherte Theorie des Planeten 1 Ceres, *A. N.*, **273**, 24.

25: E. Rabe, Eine zweckmässige Methode zur Berechnung der allgemeinen Störungen der Planeten, *A. N.*, **273**, 209.

Band 6, No.

1: Elemente und Numerierung von Kleinen Planeten, *A. N.*, **273**, 283.

2: G. Stracke, Die Eros-Bewegung von 1942-45 und die Eros-Ephemeride für 1944-45, *A. N.*, **274**, 21.

Among the many other publications by the Rechen-Institut we list:

A. Kopff, Zur Vereinheitlichung der Berugssysteme von Sternkatalogen, *A. N.*, **270**, 73, 1940.

G. Stracke, Die Eros-Bewegung von 1930-40, Anh. der Preuss. Akad. d. Wiss., 1940, No. 7.

E. Rabe, Verschollene und nicht gesicherte Kleine Planeten, *Das Weltall,* **41**, 181, 1941.

E. Rabe, Bemerkungen Über die oskulierenden Elemente in der speziellen Störungsrechnung, *A. N.*, **272**, 208, 1942.

W. Gliese, Durchmesser—und Helligkeitsbestimmungen des ersten Schwassmann-Wachmannschen Kometen (1925 II) im Jahre 1941, *A. N.*, **272**, 269, 1942.

Katalog der Anhaltsterne für das Zonenunternehmen der AG, Veröff. No. 55, 1943.

In addition, several important mathematical tables by J. Peters.

6. *Heidelber. Veröffentlichungen:*

Bd. 12, No.

5: H. Klauder, Über die effektiven Temperaturen von Bedeckungsveränderlichen, *A. N.*, **270**, 286.

6: K. Reinmuth, Photographische Positionbestimmung von 207 Nebelflecken.

7: E. Kollnig-Schattschneider, Lichtelektrische Beobachtungen veränderlicher Sterne, *A. N.*, **271**, 85.

8: S. Temesvàry, Zur Theorie der neuen Sterne.

9: K. Himpel, Über den Lichtwechsel von UZ Tauri und X Virginis, *A. N.*, **272**, 60 (10).

Bd. 13:

M. Brendel und K. Boda, Tafeln zur Verwandlung von Rektaszension und Deklination in Länge und Breite auf 0°001.

Bd. 14, No.

1: H. Vogt, (I) Zur Theorie des Sternaufbauers; (II) Entartung im sterninnern; *Abh. d. Heidelberg Akad. d. Wiss.*, 1940.

2: K. Himpel, Zum Problem der vermissten Sterne, *A. N.*, **272**, 271 (14).

3: H. Vogt, Konvektion im Sterninneren.

4: H. Vogt, Zur kosmologischen Deutung der Spiralnebel.

Bd. 15, No.

1: W. Lohmann, Der Dichtegradient in Sternatmosphären, *A. N.*, **273**, 74 (14).

2: E. Kollnig-Schattschneider, Die veränderlichen Sterne im Kugelhaufen M 13, *A. N.*, **273**, 145 (14).

3: H. Klauder, Bemerkung uber den Koeffizienten der Strahlungsviskosität, *A. N.*, **273**, 189.

Mitteilungen:

*42: H. Vogt, Das Problem der Spiralnebel, 1940.

43: H. Vogt, Die Energiequellen der Sterne, *Scientia,* **71**, 101, 1942.

*44: Kubach, Bericht über die Kopernikus-Gesamtausgabe, 1943.

45: H. Vogt, Die chemische Zusammensetzung und die Entwicklung der Sterne, 1944.

Books:

H. Vogt, Aufbau und Entwicklung der Sterne, Leipzig 1943.

**In press,* in *Astr. Nachr.:*

H. Vogt, Der Einfluss der Rotverschiebung auf die scheinbaren Helligkeiten der aussergalaktischen Nebel.

H. Klauder, Über die Verteilung der Rotationsgeschwindigkeiten der Sterne.

J. Groeneveld, Lichtelektrische Beobachtungen ausgewählter veränderlicher Sterne.

*In press, book: H. Vogt, Die aussergalaktischen Nebel, Leipzig.

7. *Munich:*

W. Rabe, Micrometermessungen von Doppelsternen, *Veröff. Sternwarte München,* Bd. 2, Nr. 1, 1939.

8. *Göttingen:*

The last publications received from Göttingen before the war were issued late in 1940. Since that time have appeared:

Veröffentlichungen:

69: H. Kienle, J. Wempe und F. Beileke, Die absolute Intensitätsverteilung im kontinuierlichen Spektrum des mittleren A0-Sternes, 1940.

70: O. Heckmann, Geodätische Linien und Newtonsche Bewegungsgleichungen, 1941 (10).

71: W. Fricke, Über die Relaxationszeit in Sternsystemen, 1941 (8).

72: K. O. Kiepenheuer, Über die Austrahlung der Sonne im fernen Ultraviolett; I, Theorie der chromosphärischen Eruptionen, 1941 (4, 9).

73: P. ten Bruggencate, Über die Natur der Fackeln auf der Sonnenscheibe (Photometrie von Fackelgebieten), 1942 (9).

74: P. ten Bruggencate und H. Müller, Untersuchungen der Granulation der Sonne, 1942 (9).

75: P. ten Bruggencate, Zür Lindblad'sschen Rotations Theorie der Milchstrasse, 1943.

77: P. ten Bruggencate, Zur Theorie der Protuberanzen, 1944.

78: P. ten Bruggencate und H. von Klüber, Temperatur und Elektronendruck in Sonnenflecken, 1945.

Other publications issued from Göttingen:

O. Heckmann, Zur Kosmologie, *Nachr. Gesell. d. Wiss. Gött.,* Bd. 3, No. 15, 1940.

P. ten Bruggencate, Bemerkung zur anschaulichen Ableitung der Oortschen Formeln für die differentielle galaktische Rotation, *A. N.,* **274**, 1943.

P. ten Bruggencate, Wasserstoffhäufigkeit und Turbulenz in der Sonnenatmosphäre, *V. J.,* **76**, Heft 4, 1941 (9).

P. ten Bruggencate, Zum 400. Todestag von Nikolaus Coppernicus, *Gött. Gelehrte Anz.* 205, Nos. 5 and 6, 1943.

P. Jordan, Über die Entstehung der Sterne, *Phys. Zeits.,* **45**, No. 9-12, 1944.

P. Jordan, Zur Theorie des Farbensehens, *Phys. Zeits.,* **45**, No. 16-18, 1944.

Seven publications were obtained in *manuscript* form:

P. ten Bruggencate, Die Anregungstemperatur und die wirksame Schichtdicke für Fraunhoferlinien in der Sonnenatmosphäre, *Zeits. f. Ap.,* **23**, 119, 1944.

P. ten Bruggencate, Die Alterbestimmung von Sternen; ein Beitrag zur Jordan'schen Kosmologie, *Nachr. Akad. Wiss. Gött.*

P. ten Bruggencate, Zur Mitte-Rand-Variation der Fraunhoferlinien auf der Sonnenscheibe, *Naturwiss.*

W. Becker und P. ten Bruggencate, Über ein neues Konstruktionsprinzip beim Spektrohelioskop und beim Spektroheliographen, *Zeits. f. Instr.*

W. Becker, Über die Notwendigkeit einer Reform der astronomischen Integralphotometrie, I. (Written in Vienna.)

W. Becker, Kolorimetrische Untersuchung an offenen Sternhaufen in den Standard-Spektralbereichen der Integralphotometrie; N.G.C. 7654 (M 52) und Umgebung. (Written in Vienna.)

P. Jordan, Zur Theorie entartener Sterne.

9. *Berlin-Babelsberg. Veröffentlichungen:*

*Bd. XII, Heft 5: L. Courvoisier, Katalog von 1668 Reststernen des Zonenunternehmens der *A. G.*, 1941 (10).

Kleinere Veröffentlichungen:

*22: H. Schneller, Katalog und Ephemeriden Veränderlicher Sterne für 1941; issued in 1940.

23: C. Hoffmeister, Beobachtungen der Leuchtstreifen in Südwestafrika, 1940.

*24: C. Hoffmeister, Die veränderlichen Sterne der nördlichen Milchstrasse, Teil II, 1941.

*25: H. Schneller, Katalog und Ephemeriden Veränderlicher Sterne für 1942 (1941).

*26: (Title not available, but probably same for 1943), 1943.

27: C. Hoffmeister, Beiträge zur Kenntnis des Lichtwechsels von 326 veränderlichen Sternen am Südhimmel, 1943.

28: P. Ahnert und C. Hoffmeister, Die veränderlichen Sterne der nördlichen Milchstrasse, Teil III, 1943.

Katalog und Ephemeriden Veränderlicher Sterne für 1944, was destroyed by fire.

Babelsberg issued further many articles in *A. N., Zeits. f. Ap., Beobachtungs Zirkulare, Die Sterne.* Also, a new series was started, *Mitteilungen Veränderlicher Sternen* (MVS), of which 48 had appeared by the end of 1943.

10. *Potsdam.* The last of the *Publikationen,* No. 96, was issued in 1939. *Mitteilungen* 1-12, which appeared in 1940-41, have been circulated in the U. S. by *C. D. A. L.* One additional issue, No. 13, appeared in 1942: *W. Becker und W. Strohmeier, "Spektralphtometrische Untersuchungen an δ Cephei-Sternen, VIIIa." A number of summarizing articles were published by Kienle, Wurm, and von Klüber, of which we cite a few:

*K. Wurm, Die Neuen Sterne (Novae und Supernovae), *Naturwiss.,* **28**, 735, 1940.

*H. Kienle, Das kontinuierliche Spektrum und die Farbtemperatur der Sonne, *Naturwiss.,* **29**, 124, 1941.

*H. Kienle, Farbtemperatur und effektive Temperatur der Sterne, *Forsch. und Fortschritte,* **17**, 117, 1941; Research and Progress VII, 220, 1941.

*H. Kienle, Die empirischen Grundlagen des Masse-Leuchtkraft-Gesetzes, *Ergebnisse der exakten Naturwiss.,* **20**, 89, 1942.

*K. Wurm, Zur Konstitution der Venusatmosphäre, *Naturwiss.,* **29**, 471, 1941.

*K. Wurm, Das Spektrum des Ro-Sternes HD 182040, *Naturwiss.,* **29**, 686, 1941.

*K. Wurm, Moleküle im interstellaren Raum, *Naturwiss.,* **29**, 694, 1941.

W. Becker published his book, "Sterne und Sternsysteme," Leipzig, 1942, but the 8th edition of "Newcomb-Engelmann's Populäre Astronomie" evidently did not get completed.

11. *Hamburg-Bergedorf. Astronomische Abhandlungen:*

Bd. V, No. 2: A. Günther, Spektralphotometrische Untersuchungen von δ Cephei-Sternen, 1939.

3: R. Schorr, C. Vick und J. Larink, Die Beobachtungen des Planeten 433 Eros während des Opposition 1930-31, 1939 (10).

4: F. W. Mävers, Untersuchungen der offenen Sternhaufen NGC 7092 (M 39), NGC 7209 und NGC 7243, 1940 (8).

Mitteilungen:

46: J. Hellerich, Bemerkung zur Dichteverteilung bei den δ Cephei-Veränderlichen, 1939.

47: A. Schwassmann, Die Bestimmung der räumlichen Verteilung der Sterne als Ziel des Unternehmens der Bergedorfer Spektraldurchmusterung, 1940.

48: J. Hellerich, Über die Beziehung zwischen den Amplituden der Licht- und Geschwindigkeitskurven bei den δ Cephei-Veränderlichen und verwandten Typen, 1940.

49: O. Heckmann, Der Einfluss der atmosphärischen Dispersion bei Van Biesbroecks Bestimmung der Aberration eines aussergalaktischen Nebels, 1942 (8).

50: J. Larink, Über die Aufstellung eines Generalkatalogs schwacher Sterne, 1942 (14).

51: K. Wurm, Die Natur der Kometen, 1943.

52: E. Kopff, Untersuchung der offenen Sternhaufen IC 4665, NGC 6633, IC 4756, 1943.

53: A. A. Wachmann, Über einen neuen Nebelhaufen in Ursa Major, 1943.

54: O. Heckmann, Skizze eines neuen Spektroheliographen, 1944.

55: O. Heckmann, Das statistische Gleichgewicht eines freien Systems von Massenpunkten, I, 1944.

Finally, the *Jahresbericht* for the years 1939, 1940, 1941, and 1942, as well as some short papers on observations in the *A. N.* and *Beobachtungs Zirkulare.*

Heckmann's useful book, "Theorien der Kosmologie," Berlin, 1942, has been mentioned before.

12. *Fraunhofer Institute.* Publications have been listed and reviewed in the text above, except:

K. O. Kiepenheuer, Die Ausstrahlung der Sonne im fernen Ultraviolett, *V. J.*, **76**, Heft 4, 1941 (9). *Cf.* also *Göttingen Mitteilung* No. 72.

FOOTNOTES

[1] *Vierteljahrsschrift d. A. G.* (= *V. J.*), **79**, 1, 1944.

[2] *Veröff. Sternwarte München,* Band 2, No. 1.

[3] Earlier Maj. Grotrian was in command of a technical company (Forschungs-Kompanie) composed of student soldiers that manned the chain of ionosphere stations from Tromsö, Norway, to Syracuse, Sicily.

[4] Also taken from Uccle was the 1-meter (f/3) reflector. It was removed by the Wehrmacht with mounting in June and July, 1940, with technical assistance from Zeiss. It was first used on the Channel coast (infrared observations on shipping). The remnants of the instrument are now reported to be at Gdynia, Poland.

[5] Katalog der Anhaltsterne für das Zonenunternehmen der *A. G.* (nach Beobachtungen an den Sternwarten Babelsberg, Bergedorf, Bonn, Breslau, Heidelberg, Leipzig und Pulkowo), *Veröff. d. Kopernikus-Instituts* Nr. 55, 1943.

[6] L. Courvoisier, Katalog von 1668 Reststernen des Zonenunternehmens der *A. G., Veröff. Berlin-Babelsberg,* Band XII, Heft 5, 1941.

[7] BHF = Bevollmächtigter für Hochfrequenz Forschung, or plenipotentiary