TABLE I. Incorporation of Glucose-2-C^{14} into Liver and Tumor RNA Ribose of Yoshida Ascites Bearing Rats.

	Ribose carbon No.				
	1	2	3	4	5
Tumor	36.2*	100	40.6	45.4	30.8
	35.2	"	45.4		
Liver	100	"	94.4	93.5	84.4
	90.5	"	72.7	93.6	72.7
Control liver	34.4	"	5.3	0	0
(Tumor-free rat(4))	23.6	"	2.0	0	0

* Values expressed as % of specific activity in C_2.

tumor of the administered glucose-2-C^{14} results in a randomization of label throughout the hexose; the observed pattern of ribose labeling in the liver resulting from normal pentose synthesis by the liver, utilizing, however, a hexose precursor in which all carbon atoms are labeled. This latter alternative is supported by the recent finding that glucose-2-C^{14} administration to tumor-bearing mice resulted in liver glycogen containing C^{14} distributed throughout all carbons of the hexose (8). These findings have been interpreted as indicating that the tumor caused an extremely active reversible conversion of the administered C^{14} glucose through the Embden-Meyerhoff and tricarboxylic acid cycles resulting in migration of the C^{14} from its original position to other locations in the glucose molecule. Whether these alterations are due to the tumor *per se* or to the indirect influence of the presence of the tumor on the metabolism of other tissues remains obscure.

While uncertainty as to the labeling pattern of the hexose precursor of ribose in tissues of tumor-bearing rats precludes precise interpretations of the pathways of pentose biosynthesis, the preponderance of label in carbon 2 of ribose would seem to eliminate decarboxylation of hexose as the dominant reaction in pentose biosynthesis(4).

Summary. Pathways of pentose biosynthesis in the liver and tumor of control and tumor bearing rats have been studied employing glucose-2-C^{14} as the isotopic precursor. Presence of the tumor in the animal caused marked alteration in the labeling pattern, of liver RNA ribose, with the C^{14} being distributed almost equally throughout the carbon chains. However, tumor RNA ribose is characterized by greater isotopic asymmetry with carbon atom 2 being most radioactive. Possible metabolic mechanisms underlying these observations are discussed.

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Plasma Catechol Amines in Psychiatric Patients. (23228)

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Interest in the determination of plasma concentrations of catechol amines has increased since the development of sensitive fluorometric methods by Lund(1) and Weil-Malherbe and Bone(2). The ethylenediamine method of Weil-Malherbe and Bone is more sensitive but less specific to epinephrine and norepinephrine than the Lund method. It has been used to follow the changes in blood levels of catechol amines in psychiatric

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TABLE I. Concentration of Catechol Amines in Plasma of Psychiatric Patients.

	Subjects	Conc. of amine (μg/liter)* Epinephrine	Norepinephrine
Patients	48	1.2 ± .10	3.3 ± .24
Controls	27	1.2 ± .09	3.0 ± .25
P value		>.8	>.4

* Mean ± S.E.

clinics following therapeutic treatment(3.4). The ethylenediamine method has also been found reliable in measuring the altered levels of circulating norepinephrine and epinephrine found in pheochromocytoma(5) and a modification of the method(6) has been used to follow changes in amine levels in patients undergoing various surgical procedures(7). Several workers have used the ethylenediamine method to measure the changes in circulating catechol amines after anesthetic(8.9) and other drug actions(10.11.12) in experimental animals.

It is the purpose of this paper to report the levels of circulating catechol amines, with fluorescent spectral characteristics similar to epinephrine and norepinephrine, in psychiatric patients of various diagnostic categories.

Methods and chemical procedure. The catechol amine content in plasma was measured by the method of Weil-Malherbe and Bone(1). The test was started immediately after the blood was drawn. All of the chemical tests were performed by the same person. Slight modifications were made in the methodology. The amines were adsorbed from heparinized plasma by shaking with alumina washed free of fluorescent material. The alumina used was the non alkaline type (Woelm brand) recommended by Aronow. The use of double distilled water and ethylenediamine redistilled daily resulted in a minimum of fluorescence in the blanks. The fluorescence of standard solutions of crystalline epinephrine and norepinephrine were always compared to the unknown samples. Recoveries averaged 90% for both amines.

Fluorescence of ethylenediamine-coupled amines was measured in a Farrand fluorometer Model A, equipped with a photomultiplier tube. The primary filter system was composed of Corning filters numbers 5113 and 3389, which passed the 436 mμ line. One secondary filter consisted of Corning numbers 5433 and 3384, which passed a band in the region of 510 mμ and the other secondary filter was a Corning number 2418 with a cut off at approximately 600 mμ. *Psychiatric Evaluation.* Patients were selected from the inpatient service of the Payne Whitney Psychiatric Clinic and represented a range of diagnostic categories and of emotional disturbance. Evaluation of the patient's diagnostic and emotional status at the time of testing was made by one of the authors (P.R.) who was familiar with all of the patients. Control subjects were hospital employees (physicians, nurses, laboratory and clinical workers) who showed no clinical evidence of psychiatric illness. In all, 48 patients and 27 controls were studied. Although most patients have received many repeated studies, only the first observations are reported here.

Results. Twenty-one of the patients studied had schizophrenic reactions, 19 affective disorders, 4 paranoid reactions, and 4 psychoneurotic reactions. In 48 samples of plasma, obtained from patients and tested for catechol amines of the epinephrine and norepinephrine type, considerable variation in the plasma amine level was observed. The range of epinephrine values in 48 patients varied from zero to 2.5 μg/liter of plasma, while the range of norepinephrine values varied from 0.1 to 8.6 μg/liter of plasma. The range of epinephrine values in 27 controls varied from zero to 2.5 μg/liter of plasma and the range of values for norepinephrine varied from 0.4 to 5.6 μg liter. These data, tabulated in Table I, showing a comparison between catechol amine levels of patients and controls, were obtained within the same time period. No significant difference was found between the

TABLE II. Concentration of Catechol Amines in Plasma of Patients of Different Diagnostic Categories.

Diagnostic category	No. of patients	Conc. of amine (μg/l)* Epinephrine	Norepinephrine
Schizophrenic	21	1.1 ± .17	3.3 ± .39
Affective reaction	19	1.3 ± .16	3.3 ± .42
Paranoid "	4	.75 ± .22	3.3 ± .47
Psychoneurotic	4	1.5 ± .40	2.3 ± .14

* Mean ± S.E.

TABLE III. Fluorescence of Possible Interfering Substances in Weil-Malherbe and Bone Method.

Compound	Conc. μg/100 ml	% of fluorescence produced by 1 μg/100 ml of Epinephrine	% of fluorescence produced by 1 μg/100 ml of Norepinephrine
Dihydroxyphenylalanine	100	15	0
3 hydroxytyramine	1	60	100
Tyramine	5000	20	30
5 hydroxytryptamine	200	0	40

data of the patients and controls.

A further analysis was made of the patient group in which the patients were considered as to diagnostic category (Table II). A test of significance was made between each diagnostic category as compared to the controls. The only significant difference observed was that of the norepinephrine levels in the psychoneurotic group as compared to the control norepinephrine levels. A "P" value of .02 was found but the sample of 4 psychoneurotics is to be extended before we positively assign significance to this category.

Interfering Compounds. Three of the compounds considered to interfere with the ethylenediamine test were compared to 1 μg % solutions of epinephrine and norepinephrine (Table III). These compounds, dihydroxyphenylalanine, tyramine and 5 hydroxytryptamine showed interference qualitatively similar to that reported by Weil-Malherbe and Bone(2). The fourth compound, 3 hydroxytyramine, was found to interfere with both epinephrine and norepinephrine in equivalent concentrations. Our data are in agreement with those of Valk and Price(13) that this compound, if present in plasma, could seriously interfere with the ethylenediamine method.

Discussion. The ethylenediamine method used to determine the level of circulating catechol amine has been criticized by Valk and Price(13). They indicate that the ethylenediamine method is not specific to the amines, particularly norepinephrine, and possibly measures a degradation product of 3 hydroxytyramine metabolism such as dihydroxyphenylacetic acid. Nevertheless, the method does reflect changes in catechol amine content of the epinephrine and norepinephrine type in cases of pheochromocytoma(5). The ratio of these amines in the patients, as measured by the Weil-Malherbe and Bone method, is in agreement with the observations of Holton (14), Engel and Euler(15) and Goldenberg and Rapport(16). Furthermore, it can be demonstrated with this method that the catechol amine level slowly returns to normal values following surgical ablation of the tumor (17). We have also observed that a patient with pheochromocytoma having preoperative levels of 3.0 and 17.5 μg/liter of epinephrine and norepinephrine, respectively, gave values of 0.8 and 3.2 μg/liter 2 weeks post operatively. Thus it appears that the ethylenediamine method gives measurements which follow the clinical picture in cases of pheochromocytoma.

Experiments devised to determine a constant quality or quantity in the interfering substances have not been successful. The interference can be due to 3-hydroxytyramine, as indicated by our test (Table III) and that reported by Valk and Price(13). It remains to be demonstrated, however, that this compound or any other dihydroxy catechol derivative will persist in plasma. At this time, therefore, it would seem best to accept the conservative evaluation of the Weil-Malherbe and Bone method which was proposed by Hammond *et al.*(7). They state that the values reported by them as epinephrine and norepinephrine may include other compounds and that these values may be legitimately accepted as maximal concentrations of plasma epinephrine and norepinephrine. It is probable that the absolute values for these amines are lower than reported by the ethylenediamine method; nonetheless, the method has been useful in following fluctuations in catechol amine content.

The data presented in this report demonstrated that a group of psychiatric patients did not maintain blood levels of catechol amines that differ in general range from the blood levels of "normal" individuals. The findings are in agreement with those found in a study of surgical cases(7), and are in keeping with studies of most physiological vari-

ables in psychiatric patients. Most studies, however, have indicated that significant findings depend on the use of repeated examinations of the individual, in different situations (18-21). Our incomplete series of multiple testings indicate that this finding applies to blood catechol amines, and warrant further exploration with this method.

Summary. The concentrations of catechol amines with fluorescent absorption spectral characteristics similar to epinephrine and norepinephrine were determined in patients and hospital personnel in a psychiatric hospital. No significant differences were found in blood levels of catechol amines in these two groups. There were also no significant differences observed in the catechol amine levels among the various diagnostic categories within the patient group. L dihydroxyphenylalanine, tyramine, and 5 hydroxytryptamine do not appreciably interfere with the ethylenediamine method. 3 hydroxytyramine had a fluorescent potential equivalent to that of epinephrine and norepinephrine when these compounds were compared in the ethylenediamine method.

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Electrophoretic Patterns in Acute Acquired Hemolytic Anemia.* (23229)

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In the study of the immunohematology of acute acquired hemolytic anemia, the nature and behavior of the serum proteins attracted attention. An abnormal distribution of the protein fractions was suggested by the greatly accelerated sedimentation rate, autoagglutination, and high antibody titer. The only reference to this subject in man is a short note by Hansen(1) in which 3 of 4 cases of acquired hemolytic anemia are reported to have had elevated gamma globulins. Boyd has summarized the results in excess antibody production in animals(2).

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Material and methods. Eight cases of ac-